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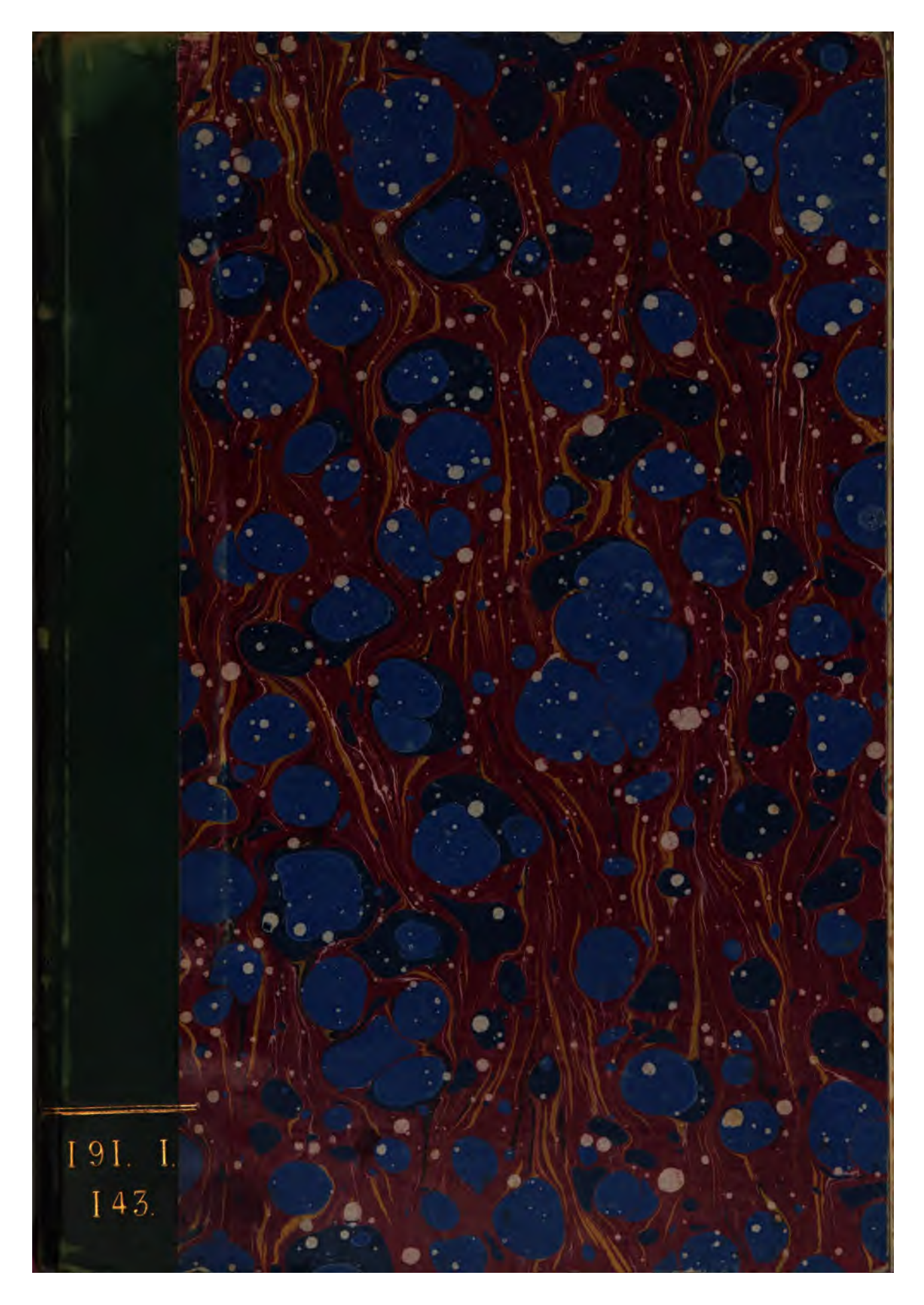
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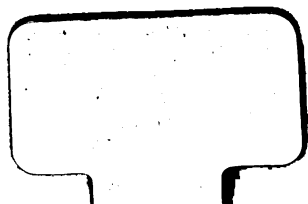
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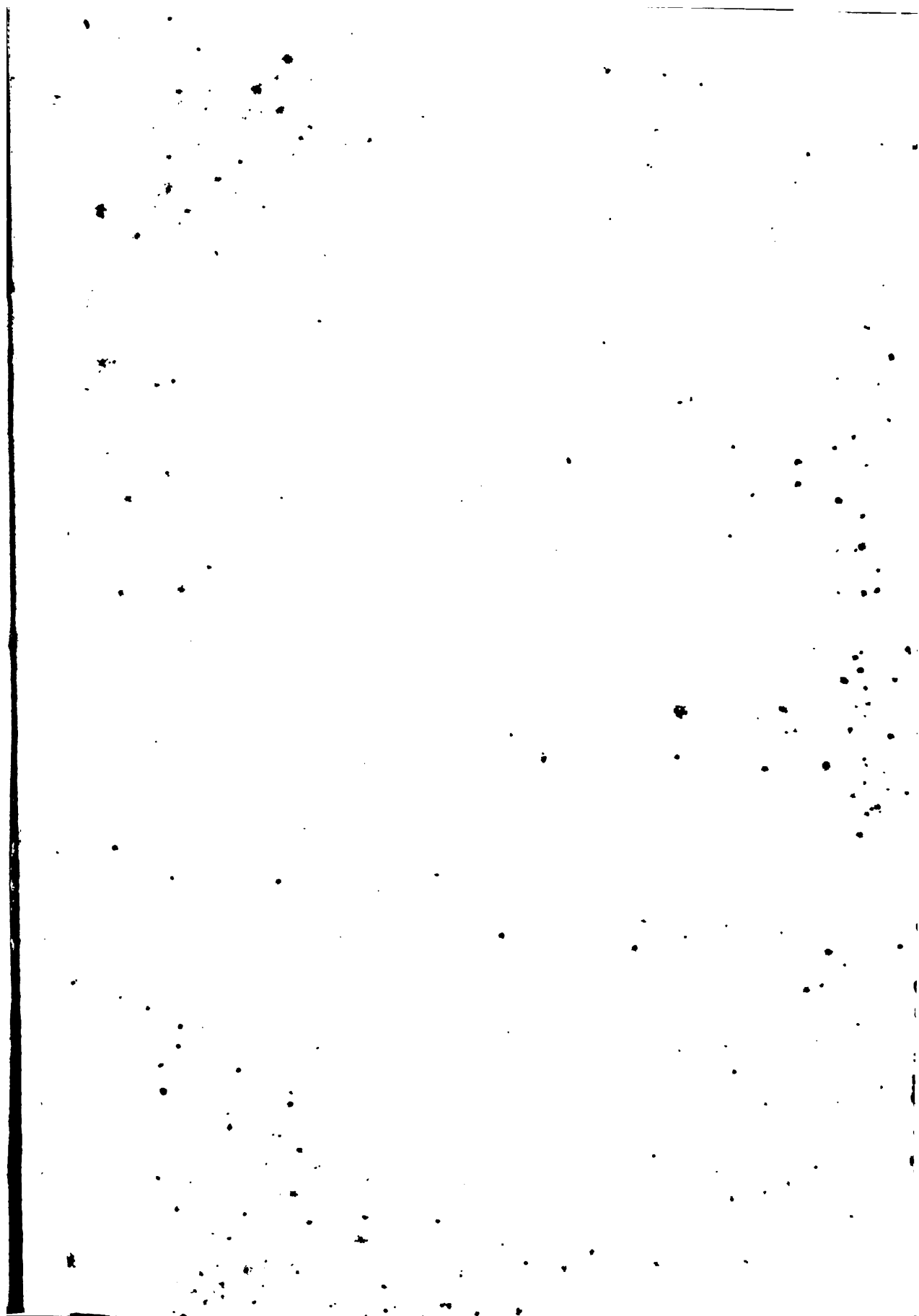
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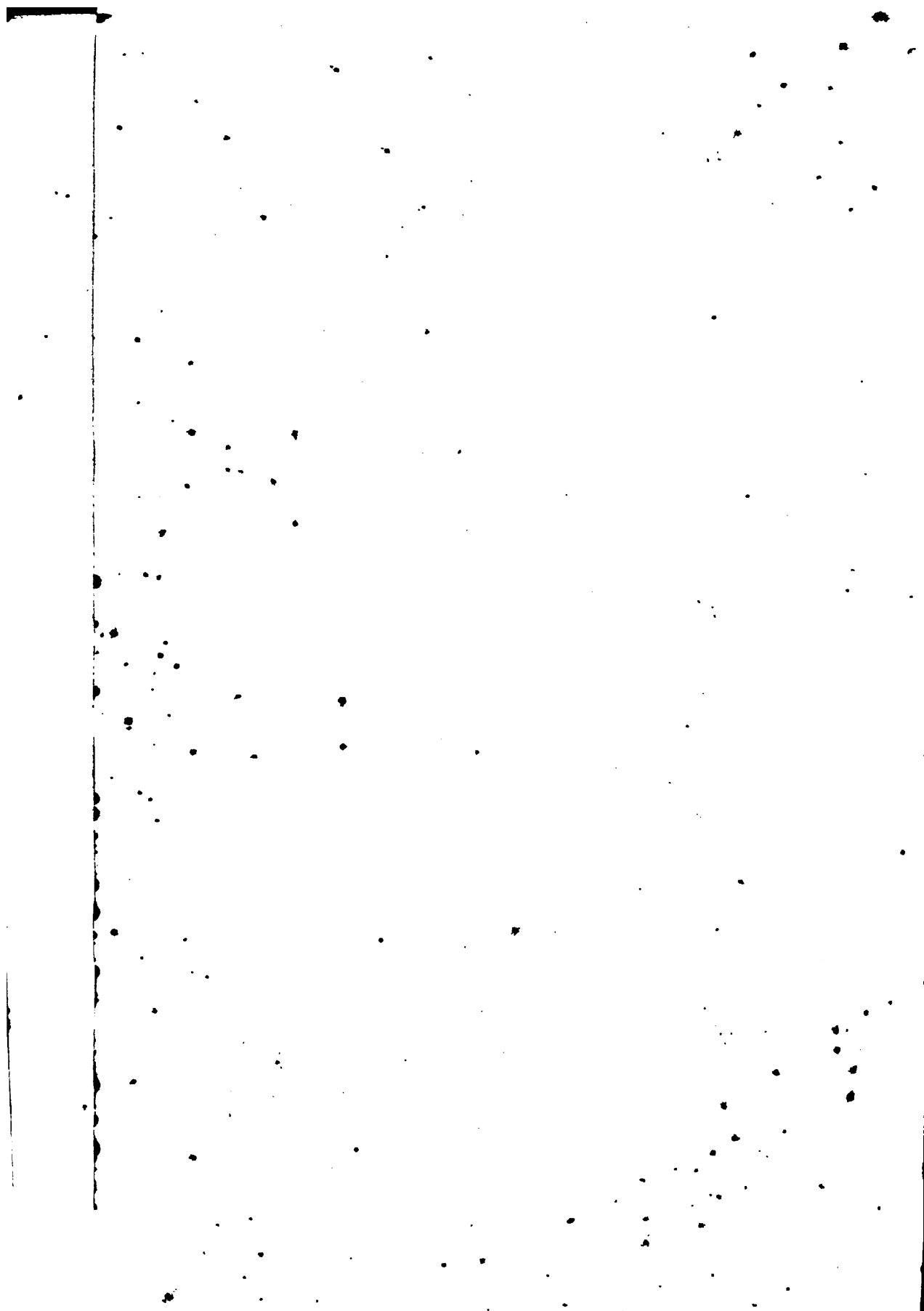
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191. I.
143.







ECONOMIC PRODUCTS
OF THE
NORTH-WESTERN PROVINCES.

PART I.

GUMS AND GUM-RESINS.

By EDWIN T. ATKINSON, B.A.,
Bengal Civil Service.



ALLAHABAD:

NORTH-WESTERN PROVINCES GOVERNMENT PRESS.

1876.



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P R E F A C E.

As early as 1865 I commenced a series of notes on the economic products of these provinces, intended to form the basis of an industrial survey on a smaller scale but similar in character to that which has been recently proposed by Dr. F. Watson. These notes have now been classified, and have been thrown into the form of a series of lists of the products which are utilised, or may be utilised, for commercial purposes. I have throughout confined myself to the products of these provinces only, and have only referred to those of other provinces when of a kindred nature, or when necessary to explain the value or use of the local product. These notes, though very imperfect, contain a fair exposition of the state of our knowledge regarding the subjects of which they treat. They only pretend to sketch the results of all previous local inquiries, and to point out where these have failed, and where further and more accurate investigation is necessary, and also to give such a description of the products themselves that require notice as will, in almost every case, prevent any confusion as to their identification. At present the vernacular synonymy of our commonest useful plants is in the greatest confusion, and it requires some time and trouble to satisfy oneself as to what particular product a man is writing about when the vernacular name alone is used. The common maize in Bundelkhand takes the name by which the *Sorghum Indicum* is known in Rohilkhand, and the latter in Benares assumes the name by which the *Penicillaria spicata* is known in the northern districts. The confusion is even greater in the less well-known grains, which collectively form such an important element in the food resources of these provinces, especially in the poorer districts, and we possess no work explaining this synonymy. Had there been such a work in existence we should not have the grave errors observable in almost every printed paper on the subject. The Agra Exhibition Committee in their remarks¹ on *patsan*

¹Catalogue, page 81.

(*Crotolaria juncea*) write :—"Of the produce of the North-Western Provinces there was a very fair show. There was not a single specimen contributed from Bengal, where this fibre is produced of a much superior quality to that grown in these provinces. The jury remark on this as strange : it may be due to the use of the name *patsan* in the prize list, instead of the mercantile name, *jute*." With the exception perhaps of a small portion of the Gorakhpur district adjoining Bengal, *jute* is not grown in these provinces, nor is *patsan* ever confounded with it in commercial phraseology. The *jute* is the *Corchorus olitorius*, and not even of the same genus as the *patsan*. The error committed in 1867 has since been stereotyped, and recent reports give the name *jute* to the *patsan* or *sani* of these provinces, and describe the plant and its produce as if it were the *jute* of commerce.

It is the object of the following pages to make a beginning towards diffusing a more accurate knowledge of our useful products, and to lay the foundation for an exhaustive description of them and their uses, locality, quantity procurable, amount of supply, whether the supply is limited to certain seasons or certain years, agency through whom procurable, and the price in maunds of 40 sers of 80 tolas each delivered at certain well-known places, either in a raw state or after undergoing such preparation as is customary. It will be seen that in regard to very many substances our information is of the vaguest description, and generally wherever any particulars desired are not given, it is because no trustworthy materials are as yet procurable. There are numerous observers throughout the country to whom it will be a labour of love to furnish the result of their own experience, and to such I need hardly say that their co-operation will be gladly welcomed. No well-attested fact regarding any substance should be considered too trivial for record, for it will find its place amid the mass of facts collected, and serve to correct or corroborate similar observations made in other districts.

I believe that in course of time we shall have materials from which we can arrive at the determination of a great number of articles and their general nature, which has, hitherto, been not even surmised. Comparison, too, will enable one to collect a series of

samples representing different varieties and qualities of the same article from which great results may be expected. Materials will be accumulated from which a complete description of every product can be written, and a numerical determination of the properties which fix its value can be made. These, too, are the advantages claimed by Dr. Watson for his system—advantages which are attainable without the cumbrous, unsatisfactory, and expensive machinery suggested by him.

But to render any result of these inquiries of practical and permanent value, there must be something of the nature of an economic museum in which specimens of each substance collected should, after comparison, identification, and classification, be deposited for reference. Anything written about them would then have a living value, and any errors made could easily be corrected. There is no subject perhaps regarding which so much has been written and spoken as “the development of the resources of the country.” The phrase is a pretentious one, and has a rounded, rolling sound worthy of many of the ideas launched in its name, but really expresses what must form one of the first duties of every civilised Government. As early¹ as June, 1804, a Mr. Gott was deputed to examine the forests of Rohilkhand and Gorakhpur, with the view of ascertaining what local products could be advantageously brought to the notice of the European world, and late in the same year he obtained advances for hemp and flax cultivation in Bareilly. He was followed by Laidlay and others, who examined into many of the questions which even now are made the subjects of enquiry. Their reports lie unused and unknown amid the twelve hundred volumes of records composing a portion of the immense library of our Board of Revenue, and surely it would be a saving of money and labour if these reports were given to the official and non-official public. My own enquiries have shown me that it is the tendency of all these questions to crop up in cycles, with the same result, the same perfunctory procedure; and were official memory long enough to recollect what has already been done and know where to find it, one-half of the erratic circulars which now puzzle and worry the district officers might be answered by a

¹ Board's Rec., June 15, 1804.

reference to the correspondence on the same subject. The mutiny undoubtedly has had much to say to this forgetfulness of what has passed, for, while purifying the local record-rooms of much that was positive lumber, it was not discriminating in the process, and has deprived us of much which was valuable and useful. A review of the efforts made in the past to attain a knowledge of the resources of the country is not unmixed with regret. They have all gone by without leaving any permanent trace behind them, and without really advancing our knowledge one single step, because they wanted organisation. The best collection of indigenous products that was ever made in these provinces was exhibited in Agra in February, 1867, and the foundation of an economic museum of inestimable value could then have been easily made without any further expense. The accounts show that the sum of Rs. 2,39,005 was expended by the end of September, and it is generally believed that three lakhs of rupees, or £30,000, would hardly cover the total expense incurred. Allahabad and other places also had their exhibitions, and what has been the result, one would naturally ask. The articles exhibited were either returned, sold, or given away, and all that now remains is one inaccurate catalogue of no practical use whatsoever for any purpose, and solely valuable as containing some well-executed photographs of cattle-sheds and other ornamental works erected for the purposes of the exhibition. A tithe of the sum thus wasted would, under proper organisation, minister to all eternity to the objects which these exhibitions were intended to subserve. I propose now to publish, as time and opportunity offers, notes on the various substances of economic value produced here, and roughly divide them into gums and gum-resins, dyes and tans, fibres, oils and oil-seeds, drugs, minerals, food-grains, uncultivated products used as food, woods, and animal products of commercial value. The present part comprises the gums and gum-resins, and I have to thank Mr. W. Waterfield, C.S., for the revision of the botanical portion, and the proof-sheets, and several useful additions and corrections. The following are the chief works referred to:—

Catalogue of the Vegetable Products of the Presidency of Bombay, by G. C. M. Birdwood, M. D.; 2nd Ed.: Bombay, 1865.

Hand-book of the Economic Products of the Punjab, by Baden H. Powell, C. S.: Lahore, 1868.

The Flora of British India, by J. D. Hooker, C. B.: London, 1872-75.

Hand-book of the Indian Flora, by Lieutenant-Colonel Heber Drury, 3 Vols.: Travancore and London, 1864-1870.

The Forest Flora of North-west and Central India, by J. Lindsay Stewart, M.D., and D. Brandis, Ph. D.: London, 1874.

Transactions and Proceedings of the Agri-Horticultural Society of Calcutta from the beginning: Calcutta, 1835-1875.

The Bengal Dispensatory, by W. O'Shaughnessy, M.D.: Calcutta, 1842.

The Indian Pharmacopœia, edited by E. J. Waring, M.D.: London, 1868.

Report on Gums and Gum-resins, by Dr. Cooke: London, 1874.

Flora Indica, or Descriptions of Indian Plants, by W. Roxburgh, M.D.: Calcutta, reprint, 1874.

Cyclopædia of India and of Eastern and Southern Asia, by E. Balfour: Madras, 1857-62.

Ure's Dictionary of Arts, Manufactures, and Mines; edited by R. Hunt. Fifth edition: London, 1863.

ALLAHABAD,
The 21st February, 1876. }

E. T. ATKINSON.

ERRATA.

- Page 9, line 13 from bottom, for "monadelphous," read "monadelphous."
- „ 10, line 20 from top, for "10-5," read "10-15."
- „ 10, line 11 from bottom, for "stipuled," read "stipules and."
- „ 11, line 10 from top, for "paddm," read "paddam."
- „ 12, line 19 from bottom, for "commerical," read "commercial."
- „ 13, line 20 from top, for "obvoate," read "obovate."
- „ 13, line 22 from top, for "prominate," read "prominent."
- „ 13, line 29 from top, for "amaltas, simi, tola," read "amaltas, sim,
itola."
- „ 14, line 2 from top, for "ovaried," read "ovuled."
- „ 15, line 10 from bottom, for "ovaried," read "ovuled."
- „ 15, line 5 from bottom, for "diamater," read "diameter."
- „ 17, line 18 from bottom, for "tinctora," read "tinctoria."
- „ 18, line 30 from bottom, for "placentes," read "placentas."
- „ 21, line 7 from bottom, for "alkalics," read "alkalies."
- „ 22, line 7 from top, for "infoliolate," read "trifoliolate."
- „ 22, line 10 from top, for "obvate," read "obovate."
- „ 26, line 24 from top, for "clean," read "clear."
- „ 32, line 12 from top, for "vatica," read "vateria."
- „ 32, line 12 from top, for "lancefolia," read "lanceæfolia."
- „ 32, line 27 from top, for "calxy," read "calyx."
- „ 32, line 33 from top, for "sdl-ki-ra," read "sdl-ki-rdl."
- „ 34, line 11 from bottom, for "turberculatus," read "tuberculatus."
- „ 40, line 23 from bottom, for "Peace," read "Peuce."
- „ 45, line 20 from bottom, for "chúlga," read "chúla."
- „ 46, line 17 from top, for "cupresses," read "cupressus."

ECONOMIC PRODUCTS OF THE NORTH-WESTERN PROVINCES.

PART I.

GUMS AND GUM-RESINS.

I. GUMS.	III. RESINS.
II. GUM-RESINS.	IV. OLEO-RESINS.

GUM is defined as "a proximate vegetable product, which forms with water a slimy solution, but is insoluble in alcohol, ether, and oils; it is converted by strong sulphuric acid into oxalic and mucic acids." There are six classes of gums known to commerce, each of which admits of numerous varieties: (1) gum-arabic; (2) gum senegal; (3) cherry-gum and the gum of other stone-fruit trees; (4) gum tragacanth; (5) gum of Bassora; and (6) the gum of certain seeds and roots.¹ The first five spontaneously flow from the branches and trunks of their trees, and sometimes from the fruits, in the form of a mucilage, which dries and hardens in the air. The sixth kind is extracted by boiling water.

Gum-arabic consists almost wholly of the purest gum called *arabine* by chemists. The purest Turkey gum-arabic flows from the *Acacia vera*, a native of the Nile basin and Arabia: East India gum-arabic from the *A. Arabica*. The gum gattie of commerce is noticed hereafter. True gum-arabic occurs in commerce "in the form of small pieces, rounded upon one side and hollow upon the other. It is transparent, without smell, brittle, easy to pulverise, sometimes colourless, sometimes with a yellow or brownish tint. It may be bleached by exposure to the air and the sunbeams at the temperature of boiling water. Its specific gravity is 1.355. Moistened gum-arabic reddens litmus paper, owing to the presence of a little supermalate of lime, which may be removed by boiling alcohol; it shows also traces of the chlorides of potassium and calcium and of the acetate of potash. One hundred parts of good gum contain 70.40 of *arabine*, 17.60 of water, with a few per cents. of saline and earthy matters."

¹ Ure, II., 425.

negal is procured from *A. Seyal* and *A. Senegal*, natives of Africa. It is in pieces about the size of a partridge's egg, but sometimes larger, with a smooth surface. Its specific gravity is 1.436. It contains in 100 parts about 50 of pure *arabine*, 16.1 parts of water, and about two to three parts of saline matters. Its chemical properties are the same as gum-arabic. Capensis, Morocco or Barbary gum come from *A. karoo*, and Bedouin gum is the product of *A. tortilis* and *A. Ehrenbergii*. Gum Bassora contains *bassorine*, and is probably the produce of an acacia. Cherry-tree gum contains 52.1 *arabine*, 34.9 *cerasine*, 12 water, and one part of saline matter. *Gum Sassa* is procured from the *A. sassa*, a native of Africa, and is also known as *Opocarpum*, the Abyssinian myrrh of the traveller Bruce.¹ *Gum Tragacanth* is the produce of the *Astragalus Tragacantha*, a native of Crete. It has the appearance of twisted ribands; is white or reddish; nearly opaque, and is very ductile. It contains both *bassorine* and *arabine*, and has a specific gravity 1.384. When plunged in water, it dissolves in part, swells considerably, and forms a very thick mucilage. One hundred parts of tragacanth contain 53.3 parts of *arabine*, 33.3 parts of *bassorine* and starch, 11.0 parts of water, and from one to three parts of saline matter. The above characteristics of each class of gums will enable the reader to assign the indigenous Indian gums to their respective classes. The gum of seeds, such as linseed, sesamum, mustard, &c., need not be noticed here. There are several Indian gums known as false gum-arabics and false tragacanth, all of which are used as ingredients in dyeing or for sizing silks, in calico-printing, by shoemakers and by glaziers and glass-stainers. On gum-resins Ure² writes:—"When incisions are made in the stems, branches

Gum-resins.

and roots of certain plants, a milky juice exudes, which gradually hardens in the air, and appears to be formed of resin and essential oil held suspended in water charged with gum and sometimes with other vegetable matters, such as caoutchouc, bassorine, starch, wax, and several saline matters. The said concrete juice is called a gum-resin; an improper name, as it gives a false idea of the nature of the substance. They are all solid; heavier than water; in general opaque and brittle; many have an acrid taste and a strong smell, and their colour is very variable. They are partially soluble in water and also in alcohol; and the solution in the former liquid seldom becomes transparent. Almost all the gum-resins are medicinal substances and little employed in the arts and manufactures. The following is a list of them:—Asafoetida; gum ammoniac; bdellium; euphorbium; galbanum; gamboge; myrrh; olibanum or frankincense; opoponax; and scammony."

Oleo-resins are represented by the *lassa* of the pine and elastic gums by the produce of the *madár* (*Calotropis Hamiltonii*).

¹See Birdwood, 283; O'Shaughnessy, 301. ²II., 425.

Since writing the above I have had access to Dr. Cooke's report on gums and resins, and give here the classification adopted by him, which commends itself as being more comprehensive :—

I.—GUMS.

A.—TRUE GUMS.

- (a).—Arabic kind as *babûl* (*Acacia Arabica*).
- (b).—Cherry kind as *padam* (*Prunus Puddum*).

B.—PSEUDO-GUMS.

- (a).—Tragacanth kind, *kulu* (*Sterculia urens*).
- (b).—Dark or Moringa, *sahajna* (*Moringa pterygosperma*).

C.—ASTRINGENT GUMS as *dhák*, *palás* (*Butea frondosa*).

II.—GUM-RESINS.

A.—EMULSIVE as *gota ganba* or gamboge.

B.—FŒTID as *hing* (*Narthex Asafoetida*).

C.—FRAGRANT.

- (a).—Bdellium kind as *gúgal*.
- (b).—Benzoin kind as *lubán*.

III.—RESINS.

A.—HARD OR COPALLINE.

- (a).—PALE RESINS, as *safed damar* (*Vateria Indica*).
- (b).—DARK RESINS, as *kála damar*.

B.—SOFT OR ELEMI : *jangli badám* (*Canarium commune*).

IV.—OLEO-RESINS.

A.—BALSAMS as *bálsan-ki-tel*.

B.—VARNISHES as *bhiláwa*.

C.—TURPENTINE AND TAR ; *ganda biroza*.

The division of the true gums is based on their comparative solubility in water : those of the Arabic kind being wholly soluble, whilst those of the cherry kind swell considerably in water, but only partially dissolve. The latter include the cherry and the bassorine gums of other writers. "Of the pseudo-gums which swell in water but do not dissolve, one kind partakes of much of the character of tragacanth in being almost colourless ; the other is dark coloured, and, so far as at present known, is commercially valueless. The third group is introduced here provisionally, but it is doubtful whether such substances as kino, either that derived from *Pterocarpus Marsupium* and its allies, or from *Butea frondosa* and its allies, should not be relegated into the company of such extracts as cutch and gambier, although commonly classed with gums. Of gum-resins, the emulsive series, including gamboges of all varieties, will follow the gums in natural order in consequence of the facility with which they mix and form an emulsion with water. The fœtid gum-resins form a very natural and complete group, since all are medicinal, and the

majority are derived from umbelliferous herbaceous plants. There is also a great affinity of chemical characteristics. The fragrant gum-resins hardly constitute such a satisfactory group, which necessarily has been sub-divided into two sections,—the one to include substances of the myrrh and bdellium kind, more or less bitter to the taste, and the other the truly fragrant gum-resins, such as gum benzoin, olibanum, and other incense gums. Of the true resins, the first group contains the comparatively hard resins resembling copal, applicable to similar purposes. The commercial term of hard copal is much more restrictive, and its use is not contemplated here. Hard resins might be sub-divided again into hard and soft copals. None of the Indian resins belong to the commercial "hard copal." The division into pale and dark resins will again represent comparative value, since the black resins would not be available for the same purposes as the pale resins. Elemi resins have a different chemical composition and distinct uses, mostly medicinal, and are not available for varnish manufacture. Oleo-resins consist mainly of a resin suspended in volatile oil, and the three groups here proposed are in reality almost functional, for the balsams have little value save in medicine, natural varnishes for coating wood and iron have little other use, and turpentine with tar and rosin complete the series."

Here, as in Europe, the finer gums are used in medicine, and the gum of the *bel* (*Feronia Elephantum*) is officinal for the preparation of mucilage in the Indian pharmacopœia. Dr. F. Watson, in a recent report (1873) on certain gums and gum-resins received from India, writes:—"The only gums which can be sent to this country (England) with any chance of profit or success are gums of the *Acacia* kind, and probably also the *Tragacanth* (see below under *Sterculia urens*). Resins of the copal kind would have to compete in this market with the best copals, and therefore could hardly realise remunerative prices. It would be well if samples of other good soluble gums were sent over for report, taking into account what has already been suggested as to picking it more carefully, so as to exclude the fragments of bark, and sorting from it the darker pieces. The gums of *Acacia Arabica*, *Acacia Catechu*, *Feronia Elephantum*, and *Asadirachta Indica*, if clean and pale, and can be had in quantity, should be valued, for which purpose 10lbs. of each would suffice. Mixed gums containing pieces differing in solubility, or including bark and other foreign substances, should not be placed in competition with the cleaner and more homogeneous gum-arabics of the London market."

With reference to the above remarks, what is now wanted is the particular information regarding each kind of gum found in these provinces which shall make this general information of any value. It should be noted regarding each class of gum, the place where found and the quantity procurable, and whether the supply is limited to certain seasons or certain years. The source of

the supply and the persons by whom collected should then be given. Next the different qualities and the average price per maund of 40 sers of 80 tolas each for each quality delivered at a certain place in its raw state, and after undergoing any preparation that may be customary.

Sufficient materials exist¹ from which a proximate estimate of the annual average yield of gums and gum-resins from these provinces may be made. From enquiries made in 1867 it would appear that in the Allahabad, Meerut and Agra Divisions, and the districts of Benares, Azamgarh, Gházipur, Budaun, Moradabad, Sháhjahánpur, Jáláun, and Jhánsi, gums are not collected for sale or exportation. In Gorakhpur, the principal gums found are those of the *ním* (*Azadirachta Indica*) and the *babúl* (*Acacia Arabica*) and the oleo-resin of the *sákhu* or *sál* (*Shorea robusta*), here known as *karail*. The supply of *karail*, however, is diminishing owing to the Government forests being preserved and the jungles in the possession of private parties being gradually cleared. In Basti, the supply from these trees is small and insufficient to form an article of commerce or support a regular trade. The cotton-tree, *semal* (*Bombax Malabaricum*) grows in considerable quantities on the banks of the Rámghanga and Burha Rápti rivers, but the gum is not regularly collected, and the greater portion of the resins and gums used is imported from Nepál. This district has been so completely cleared of forest and jungle that under the most favourable circumstances no large supply of gums and resins can be obtained from it. In Mirzapur the gums and tar in local use come from Nepál, the Dún of Dehra, or from Sirgúja. A portion of the supply of *rál* from the *sákhu* is derived from the jungles of Agori-Barhar, Singrauli, and Dúdhí, and besides this, there are numerous gums which are not collected in sufficient quantities to form a supply-basis for commercial speculation.

The resinous products of the Jhánsi Division have not hitherto formed an important article of trade, though the local authorities of Lalitpur consider that "any quantity of valuable gums might be procured if proper means were employed to collect and store it." In the Rohilkhand Division, the characteristic gums of the Bijnaur district are the *jhingan* (*Odina Wodier*), *dhák* (*Butea frondosa*), *sahajna* (*Moringa pterygosperma*), and *semal*, and the opinion is that "if proper attention be paid to the subject and trained *kandiyas* (persons who extract the gum from the trees) be employed, the quantity of produce of each kind of gum would be a great deal more than is at present obtained." Similar remarks are made in Bareilly, and generally speaking, should a demand arise, the supply of *Butea kino* and *babúl* gum might be increased indefinitely, as at present these products are collected for little more than local consumption. The plantations along the canals alone would afford a very large supply of the

¹I refer to the returns collated in letter No. 13F.-C., Govt., N.-W. P., in the P. W. D. S., dated May 13th, 1867, reprint 25, Government, India, P. W. D.

latter gum, and the immense tracts of *dhák* jungle through the middle Duáb could give a large supply of the former. Taking the average of the returns of the hill forests for the years 1869 to 1872, I find the exports of gums of sorts from the Garhwál forest division to amount to 265 maunds, and of *birja*, or pine-resin, to 30,560 pitchers of about 2½ lbs. each. From the Dún the export of gums was *semli gond*, 786 maunds, and *dhák gond*, 27 maunds; and from Kumaon about 200 maunds of gums. Taking gums alone, the average yearly outturn of these provinces might be about 2,000 maunds, or about 83 tons. The exports of pine-resin are nearly of equal amount. The supply of *sál*-resin has fallen off of late years since the conservancy of the *sál* forests, all over India, has been taken in hand, and its place has been taken by other resins. The reason for this prohibition is that, in the case of both the *sál* and the pine, notches must be made in the trunk of the tree in order to promote the flow of the resin, and these notches eventually kill the tree. A similar prohibition in the case of the pine must sooner or later be made, as, even, now increasing demands on the timber reserves leave no excessive supplies of timber in the more accessible forests. On the whole, therefore, the gum resources of these provinces appear, from existing data, not to be of such a character as to lead one to expect any very profitable results from their further development.

I.—GUMS.

A.—TRUE GUMS.

(a.)—*Arabic kind.*

Dr. Cooke prefaces his list of this section of his subject with the following practical remarks:—"Before entering upon the examination of the numerous kinds contained in this group, it may be premised that there are certain elements essential to a commercially good gum, as well as to any other trade product, and that it is unreasonable to suppose that gums which do not fulfil these conditions can compete in the markets with those which do. One of the first conditions is the entire solubility of the gum in cold water, so as to form a smooth and homogeneous mucilage. Gum which does not wholly dissolve in cold water, but which would dissolve by the application of heat, though not of the first class, would still commend itself, if other conditions were fulfilled. There are purposes to which cherry-gums and the tragacanth are applied, but these are much less numerous or important in their demands than for a good 'Arabic gum.'

"A good gum should be pale in colour. It may be true that a good and perfectly soluble gum, like *babúl* for instance, may form as smooth and tenacious a mucilage as the best Turkey arabic, but because dark coloured, and for no other reason, would have a much lower marketable value. It is scarcely necessary to add that the gum must be unmixed. Two gums, it even

may be that both are soluble, might not dissolve equally in water, or freely coalesce. This would be a disadvantage; but when two or more gums are mixed, of which one is insoluble in whole or in part, the whole sample is greatly deteriorated and reduced to almost the rate of the insoluble admixture. Hence then, commercially, it is of importance that gum should be (1) entirely derived from the same species of tree, (2) as light and uniform in colour as possible, and (3) free from all foreign admixture. There are two kinds of admixture of foreign matters to which gums are liable: one accidental, and the other fraudulent. The accidental includes bark, chips, &c., to which the gum is adherent when collected, and often to be attributed to careless collection. The fraudulent consists in the addition to what would otherwise be a good gum of foreign substances in order to increase the weight. We have seen a good pale arabic, though small, mixed with such a large proportion of sand in order to increase its weight as to render it absolutely unsaleable, except at a nominal rate. The gum was broken down to cover the deception, and hence the sand could not be sifted from the gum except by sacrifice of more than an equal bulk of powdered gum. These facts must be borne in mind in all attempts to estimate the market value of gums."

The Indian gum-arabic, or the East Indian gum and gum gattie of commerce, is properly the produce of the *Acacia Arabica*, the *babúl* Indian gum-arabic. or *kíkar* of these provinces. This tree is the same species as that from which one variety of the true Turkey gum-arabic is obtained, but difference in climate and in soil reduces the proportion of *arabine* in it so much as to make it an article very inferior to the Egyptian variety. It is, however, almost impossible to obtain the Indian gum in a pure state and unmixed with the gums of other trees. The gum that is found in the bazars under the generic name of *babúl-ki-gond*, or gum of the *A. Arabica*, consists, first, of the produce of the tree itself; secondly, of the gums of other trees, such as *A. Catechu*, *A. Modesta*, *A. Farnesiana*, *Albizzia Lebbek*, *Azadirachta Indica*, *Mangifera Indica*, *Feronia Elephantum*, *Terminalia bellerica*, *Anogeissus latifolia*, &c., each of which is described hereafter sufficiently for the purposes of identification.

Acacia Arabica, Willd. *Mimosa Arabica*, Lam. Roxb., 421 (II, 557); Brandis, 180; Cooke, 4. *Babúl*, *babúr*, *kíkar*, H. Gum, *babúl-ki-gond*.

"A tree with thorny branches. Petioles, peduncles and branchlets pubescent. Leaves glabrous, bipinnate. Stipular spines spreading, generally straight, varying in length $\frac{1}{2}$ -2 inches long, smooth, generally whitish, with sharp, often shining brown points. Pinnæ generally 3-6 pair, common petiole 1-2 inches long, cup-shaped glands at the base of the lowest, and generally also of the uppermost pair; leaflets linear, 10-20 pair. Peduncles slender, 3-5, fasciculate, with two opposite scaly bracts in the middle of the peduncle. Flowers golden yellow, fragrant, in globose heads. Corolla campanulate. Stamens free. Pod stalked, compressed, 6 inches long, moniliform, much contracted at both sutures between the seeds, whitish tomentose, rarely glabrous."

Common throughout these provinces, either self-sown or cultivated. The gum exudes naturally, or is procured by incisions in the bark, when the sap runs

out and hardens into small lumps varying in form and size. There are two kinds, the brownish red and white gum ; the former is more highly esteemed in medicine, and the latter in the arts. The gum exudes principally in March and April, and a good tree during its prime ought to yield about a ser or a little over two pounds in the year. The bazar specimens occur in broken tears of a brownish red to brown, light-brown and white colour, rather brittle with a shining fracture, and wholly soluble in water, forming a dark-coloured mucilage.

Acacia Catechu, Willd. *Mimosa Catechu*, Linn ; *A. Sandra*, DeCand ; *A. Sandra*, Bedd. Roxb., 423 (Cor. PL t. 225) ; Brandis, 186 ; Cooke, 5. *Khair*, H. Gum, *khair-ki-gond*.

"A moderate sized tree, with thorny branches and rough dark-coloured bark ; branchlets and petioles generally dark brown or purple, glabrous shining ; below the insertion of each leaf a pair of compressed, sharp, brown, shining, infra-stipular prickles. Leaves bipinnate. Common petiole 3-4 inches long, often armed with scattered prickles ; a gland below the lowest pair of pinnae, and at the insertion of the 3-4 uppermost pairs. Pinnæ 10-20 pair ; leaflets numerous, linear, imbricate, glabrous or pubescent, less than $\frac{1}{4}$ inch long, generally turning brown in drying. Spikes lax, axillary, cylindrical, pedunculate, 2-4 inches long, solitary or fascicled ; flowers small, pale yellow, sessile. Petals linear, connate at the base, 2-3 times longer than calyx. Stamens numerous, free. Pods stipitate, thin, brown, shining, 2-3 inches long, $\frac{1}{4}$ - $\frac{1}{2}$ inches broad. Seeds 3-10."

Common in the sub-Himalayan tract and Bundelkhand. This tree, better known for its produce, *kath*, the cutch of commerce, used for dyeing and tanning in Europe and for eating with *pân* and betel in India, also yields a gum which occurs in rounded tears varying in size from a walnut to a pea, of a rich dark-brown colour, rather friable and cracked and granular like coarse brown sugar. It is sweet in taste and completely soluble in water, yielding a thin dark-brown mucilage. It is collected in the same way as *babul-ki-gond* and is largely mixed with it in the bazar. A sample of this gum sent from Chanda, in 1873, for report was valued as ordinary arabic at 20s to 25s per cwt. The price in the bazar at Chanda, in the Central Provinces, was Rs. 4 per maund of 80lbs., or about Rs. 5-8 per cwt. The cost of collecting the gum in the forests was estimated at Rs. 2-8 per maund ; carriage thence to the rail and on to Bombay, Re. 1-4, or a total of Rs. 3-12 per maund, or Rs. 5-4 per cwt., in Bombay.

Acacia modesta, Wallich. *A. dumosa*, Wr. and Ar. *Mimosa dumosa*, Roxb. 422 (II, 559) ; Brandis, 185 ; Cooke, 6. *Phaldî*, H. Gum, *phaldî-ki-gond*.

"A thorny, moderate-sized tree, rarely unarmed, with grey foliage, glabrous, a few scattered hairs on petiole and peduncle. Armed with twin, strong, shining dark-brown, conical infra-stipular prickles. Leaves bipinnate, pale grey or glaucous ; pinnæ 2-3 pair ; leaflets 3-5 pair, obliquely oblong or obovate. Common petiole 1-2 inches long, a small round gland below the lowest pair of pinnae. Stipules minute, deciduous. Flowers white or pale, yellow, sweet-scented, nearly sessile, in lax, cylindrical, drooping spikes ; the spikes solitary or 2-3 together, 1-2 inches long, on slender peduncles. Petals connate beyond the middle. Stamens free. Pod stalked, flat, indehiscent, linear-oblong, 2-3 inches long, $\frac{1}{4}$ inch broad. Seeds 3-5, compressed."

Common in Sahâranpur in the sub-Sewâlik country. Brandis says that a tasteless gum exudes from the bark. Dr. Stewart remarks that this tree yields sparingly a gum similar to gum-arabic, and Powell says that the gum occurs in little curled pieces, quite soluble and of a yellow colour.

Acacia leucophlœa, Willd. *Mimosa leucophlœa*, Roxb. Roxb., 421; Brandis, 184; Cooke, 7. *Ranj, ramja, jhand*, H.

"A thorny tree, branchlets, petioles, leaves, and branches of inflorescence grey-tomentose. Armed with strong, straight stipular spines. Leaves bipinnate. Common petiole 1-2½ inches long; pinnæ 5-12 pair; small, circular, cup-shaped glands generally at the insertion of each pair. Leaflets 12-30 pair, linear. Flowers pale yellow, nearly white, in globose heads, on short peduncles, arranged in large terminal leafless panicles, two membranous bracts on the peduncle. Pods linear, curved, 4-6 inches long, ¼ inch broad, solitary, or 2-3 on one peduncle, clothed with short brown tomentum. Seeds 8-12."

Found in the Sahāranpur district, in the Jumna ravines through the Duāb, and in Bundelkhand. Ure states that gum bassora is obtained from *A. leucophlœa*, but no examination of the gum derived from the Indian species has yet been made.

Acacia Farnesiana, Willd. *Mimosa Farnesiana*, Linn. *Vachellia Farnesiana*, Wt. and Ar. Roxb. 421; Brandis, 180; Cooke, 27. *Wildyati kihar, gau-kihar*, H.

"A thorny shrub, glabrous or pubescent, armed with straight stipular spines. Leaves bipinnate. Common petiole 1½-2 inches long; pinnæ 4-8 pair; cup-shaped glands below the lowest, and often at the base of the uppermost pair; leaflets linear, ciliate or nearly glabrous, 10-20 pair. Flowers in globose heads, deep yellow, sweet-scented, supported by broad membranous bracts at the base of the head. Peduncles slender, 3-5 fasciculate. Calyx 5-toothed; corolla tubular, 5-toothed. Stamens free. Pod 2-3 inches long, glabrous, with elevated, nearly parallel, reticulate lines, turgid, nearly cylindrical, scarcely dehiscent, filled with dry spongy tissue and a double row of seeds."

Cultivated all over India. Brandis notes that a gum exudes which is collected in Sindh, and Waring states that the gum is considered a superior gum-arabic in the arts and in medicine.

Albizzia procera, Benth. *Mimosa elata*, Roxb. Roxb., 418; Brandis, 175, who gives the vernacular synonymy as *safed-siras, gurār, harra, karo, ghorar, kharanji, harinji, gurbāri, garkur*, and *baro*.

"A large tree, with yellowish or greenish white bark. Glabrous, young leaves pubescent. Leaves bipinnate, nearly as broad as long. Common petiole 6-12 inches long, with a large brown oblong gland near its base; pinnæ 3-4 pair, spreading, the upper pinnæ 6-9 inches long. Leaflets 6-8 pair, 1-2 inches long, obliquely ovate or oblong-ovate, with 6-10 prominent lateral nerves on either side of midrib. Flower-heads with 16-20 flowers, on peduncles 1 inch long or less, in fascicles of 2-5, forming large, lax, terminal panicles. Flowers yellowish white, sessile, ¼ inch long to extremities of filaments. Calyx tubular, half the length of corolla; segments of corolla oblong, hairy at the end. Stamens monadelphous. Legumes linear, 6-9 inches long, ¾-1 inch broad, with 8-12 prominent seeds."

Common near river-banks and in moist places in Gorakhpur, Oudh, and the sub-Himalayan tract west to the Jumna. Nothing is known regarding the gum.

Albizzia Lebbek, Benth. *Acacia speciosa and Lebbek*, Willd. *Mimosa Sirissa*, Roxb. *M. speciosa*, Jacq. Roxb., 417; Brandis, 176; Cooke, 5. *Siras, sirisha, kalsia, tantia*, H. Guin, *siras-ki-gond*.

"A large tree, with dark-grey bark. Extremities and leaves glabrous or pubescent. Leaves bipinnate. Common petiole 3-12 inches, a large gland near the base, and one or more interjugal glands; pinnæ 2-4 pairs; leaflets 3-9 pairs, unequal-sided, oblong, obtuse, subsessile, lateral nerves not prominent, veins reticulate. Peduncles 2-4 inches long, in fascicles of 2-4 from the upper axilla, forming a short corymbose raceme. Flowers white, fragrant, glabrous or pubescent, 1½ inch long

to the extremities of stamens, on pedicels $\frac{1}{2}$ inch long. Calyx campanulate, less than half the length of corolla, with short deltoid teeth. United base of filaments included. Legume 8-12 inches long, linear oblong, 2 inches at the broadest, of a straw yellow colour, thin, with 8-12 large, distant prominent seeds."

Common, both self-sown and cultivated, in the sub-Himalayan tract, Bundelkhand, and throughout these provinces. Roxburgh says, "I have often seen large masses of very pure gum upon it;" and the gum is esteemed as a very superior arabic variety, both in medicine and the arts. Dr. Stewart and Major Drury also mention the gum, and Mr. Baden Powell says it is not soluble entirely in water, but softens to a jelly-like size. He adds that "it is a coarse gum used for adulterating gum-arabic, and under the name of '*lera*' in the art of printing calicoes with gold and silver leaf patterns." Dr. Brandis calls it a mild pellucid gum, so that further information on this gum is desirable. It is probable that pure specimens of the gum of *A. Arabica* have been mingled with those hitherto examined, and hence the discrepancies in the reports.

Albizia odoratissima, Benth. *Acacia odoratissima*, Willd. *Mimosa odoratissima*, Roxb. Roxb., 418; Brandis, 175; Cooke 6. *Siras*, *wildiyati siras*, *siran*, *bhandir*, H.

"A large tree, with dark green foliage. Branchlets, petioles, inflorescence and underside of leaves rusty or grey-tomentose. Leaves bipinnate. Common petiole 6-12 inches long; pinnae 3-8 pair, 4-6 inches long. Leaflets 10-25 pair, 1 inch long or less, linear-oblong, unequal sided, pubescent above, pale and tomentose beneath. Flower-heads fasciculate, on peduncles $\frac{1}{2}$ - $\frac{3}{4}$ inch long, in compact corymbs; these arranged in lax terminal panicles. Flowers sessile, pale yellow, fragrant, 1 inch long to extremity of stamens, calyx and corolla hairy. Calyx small, campanulate, 4-5 times shorter than corolla. Stamens monadelphous. Legumes broad-linear, 6-8 inches long, 1 inch broad, of a red brown colour, tomentose when young, glabrous when old, with 10-15 seeds."

Sub-Himalayan tract. Brandis says that a dark-brown gum exudes from wounds in the bark. Some specimens occur in dark-brown, rounded tears, tasteless and soluble.

Others of the same family, regarding which information is desirable, are *Albizia Julibrissin*, Boivin., the pink *siras* (Brandis, 177) known as the *siris*, *larau*, *barauliya* or *lhokra*, remarkable for its light rose-coloured flowers. It occurs along the outer Himalayas from the Indus to Sikkim. *A. stipulata*, Boivin, (Brandis, 178), the *siran* or *kaunjeria* of these provinces, and the *pattiu* or *sum-sundara* of Oudh, known by its large, semi-cordate, stipuled, yellowish, inodorous flowers, the stamens slightly tinged with red and somewhat green at the tips. It occurs in Oudh and along the sub-Himalayan tract west to the Indus. *Acacia eburnea*, Willd. (Brandis, 183) also occurs along the outer Himalayas as far east as Kumaon. *A. lenticularis*, Hamilton (Brandis, 186), probably the *khain* of Maden, "an armed tree with the blossoms of the *khair* and the fruit of the *siras*," found in the forests about Barmdao and at Punagiri.

Egle Marmelos, Correa. Roxb., 428; Brandis, 57; Cooke, 8; Hooker, 15, 16. *Bel.*, H.

"Glabrous, armed with axillary, straight, strong, sharp spines, 1 inch long or more. Leaves alternate, pellucid, punctate. Leaflets 3, rarely 5, ovate-lanceolate, crenate, terminal long petiolate, lateral nearly sessile. Flowers greenish-white, with a fine honey-scent, on short lateral

panicles; pellicels and calyx pubescent. Calyx flat, teeth indistinct. Petals 4-5, oblong, coriaceous, thickly dotted. Stamens numerous, with long linear anthers. Filaments occasionally fasciated. Fruit globose, oblong, or pyriform, 2 to 5 inches diameter, with a smooth, grey or yellow rind, and a thick, orange-coloured, sweet, aromatic pulp."

Wild in the Siwálik tract and along the outer Himalayas, cultivated in every district. It yields a good gum-arabic, occurring in small fragments of tears like coarse brown sugar and of a similar colour.

Prunus Persica, Benth and Hook. fl. Brandis, 190; &c., the *aru* of the Kumaon hills. *P. Armeniaca*, Linn., the *chúdi* or *zard álu* of the same tract; the varieties of *P. communis* known in Almora as *Bhotiya baddm* and *Laddhi baddm*; and *P. puddm*, the *padm* or *páya* of the hills.

All yield a species of gum-arabic of the cherry-tree kind, of which small quantities have been examined. It occurs in tears of various shapes and sizes, usually of an amber colour. As a rule, however, the gum of the cherry and other stone-fruit trees does not form an article of trade in these provinces, owing as well to the smallness of the yield as to the presence of more useful and more productive gum-bearing trees. The *alécha* (*Prunus communis*) and *shaft álu* yield respectively the plum-tree and apricot gum of a yellowish colour and soluble in water. *P. Cerasus* and *P. Padus* (*jámana* of Kumaon) also yield a gum.

Artocarpus integrifolia, Linn. Roxb., 633; Brandis, 425; Cooke, 9. *Kathal*, H.

The jack-tree. "A large tree, glabrous, only youngest shoots with short stiff hairs; branchlets with annular raised lines, the scars of the stipules. Leaves alternate, coriaceous, smooth, shining above, rough beneath, elliptic or obovate, obtuse, midrib prominent beneath, with 7-8 main lateral nerves on either side of midrib; blade 4-8 inches, petiole $\frac{1}{2}$ -1 inch long, stipules large, with a broad amplexicaul base, sheathing in bud, early caducous; leaves of young plants and of shoots from the root often lobed. Flower-heads monoicous, ovoid, elongated, on short lateral branchlets, generally on the trunk or larger branches. Fruit large, hanging on short stalks, oblong, fleshy, with a thick cylindrical receptacle, and a muricated rind, 12-30 inches long and 6-12 inches diameter. Seeds reniform, oily."

Cultivated all over these provinces for its fruit. It yields a very dark-looking gum, soluble in water and having a dark resinous fracture. *A. Lakoocha*, (Brandis, 426), the *barhal* of Bánda, and the *dhau* or *dahu* of Kumaon, yields a similar gum.

Azadirachta Indica, Juss. *Melia Azadirachta*, Linn. Roxb., 368; Brandis, 67; Cooke, 9. *Nim*, H. *Betain* of Kumaon.

"Leaves imparipinnate, 9-15 inches long; leaflets 9-13, nearly opposite, shortly petiolate, 1-3 inches long, unequal sided, ovate lanceolate, sometimes falcate, deep and sharply serrate, acuminate, glabrous. Flowers small, white, with a strong smell of honey, especially at night, pentamerous, on short slender pedicels, with short scattered hairs, in large axillary panicles, shorter than leaf; bracts small, caducous. Calyx small, flat, with five rounded, obtuse segments. Petals spatulate, obliquely imbricate in bud. Anthers 10, linear, inserted opposite and below the teeth of the staminal tube. Ovary 3-celled. Drupe ovoid-oblong, size of an olive, smooth, dark purple when ripe; putamen cartilaginous, 1-celled, 1-seeded, reticulated outside."

Cultivated all over these provinces. Brandis notes that a gum used as a stimulant exudes from the bark. It occurs in somewhat large tears of a dark-

brown colour. Birdwood also includes it amongst the gums which make up the gum gattie of commerce. Inquiries as to quantity procurable and uses are desirable.

Bassia latifolia, Roxb., the well-known *mahua* tree of these provinces, so common in Bundelkhand and the Benares Division, where it is extensively cultivated in groves; is described by Brandis, 289, and Roxb., 411.

It yields a gum from the cracks and incisions in the bark. "By making deep incisions around the tree, a kind of white milky gum comes out, but is of no use." A verification of this statement is desirable.

Buchanania latifolia, Roxb. The *piyál*, *muriya*, *kathhildwa* of Kumaon and Garhwál, and *piár*, *paira* of Oudh. Brandis, 127; Cooke, 11; Roxb., 365.

"Young branches, inflorescence, underside of leaves, petioles, and midrib clothed with long silky hairs. Leaves alternate, simple, entire, coriaceous, generally 6-10 inches long, oblong, obtuse, with 15-20 prominent and branched lateral nerves on either side of midrib, and shorter intermediate ones. Stipules none. Panicles terminal and from the axils of the upper leaves, pyramidal. Bracts small, caducous. Flowers small, whitish green, sessile. Stamens 10. Carpels 5, distinct, hairy. 1-fertile, 1-celled 1-ovuled. Drupe black when ripe, half inch long; putamen hard, bony."

Common in the Bhábar and along the foot of the hills. Brandis notes that a pellucid gum exudes from wounds in the stem. The kernel of the fruit is known as *chironji*, and the gum as *chironji-ki-gond*, of which a good tree will yield about 5lbs. A sample from Haidarabad is described as in irregular broken fragments, brittle, pale horn colour tinged with brown, tasteless, soluble in water, forming a colourless mucilage, but containing a portion of insoluble bassorine. The sample much mixed with impurities, rendering the filtration of the mucilage necessary, otherwise the mucilage not inferior in strength to ordinary commercial arabic gum. The valuation of this sample was 25s. per cwt., and by another firm only from 15s. to 20s. A specimen of *piár* gum was examined in 1869 by Messrs. Scott, Thomson and Co. of Calcutta, who reported to the following effect:—"We find it resembles Bassora gum, but has superior adhesive properties, similar to the gum *acacia*, which gives it a higher commercial value, as it can be used in the place of *acacia* gum for dressing cloth."

Eugenia Jambolana, Lam. *Syzygium Jambolanum*, W. et A. The well-known *jáman* or *phaunda* of these provinces. Brandis, 233; Roxb., 398; Cooke, 11, 39.

Yields a gum regarding which further information is necessary before its quality or uses can be determined.

Bauhinia variegata, Linn. The *kachnár* of these provinces. Roxb., 344; Brandis, 160; Cooke, 10.

"A tree, young branches, underside of leaves, inflorescence and calyx with short pubescence. Leaves with cordate or rounded base, as broad as long; leaflets connate beyond the middle, with 5-7 nerves. Flowers in spring. Racemes short, axillary or terminal, with few flowers. Bracts small, broad, triangular. Flowers large, 2 inches long, fragrant. Calyx spathaceous, ovate, 5-toothed at the apex. Petals oblong, the fifth broader, obovate or ovate. Perfect stamens 5. Ovary-stalk cohering with the calyx-tube. Legume 6-18 inches long, linear, flat. Two varieties;

one with red flowers, 4 petals, light purple, the 5th deep purple, tinged with cream and red; the other with white flowers, *B. candida*, Roxb., 344, 4 petals white, the 5th variegated inside with yellowish green."

This tree and others of the same family yield a gum known as *sem-ki-gond*. It is said to be a brownish mild gum, like that of the cherry-tree, which swells in water and is only partly soluble. It grows wild almost everywhere. *B. purpurea*, Linn. Brandis, 160; Roxb., 344, the *koliár*, *kaníár*, *kandan*, and *khairwól* of these provinces, associated with *sál* and bambu in the Pátli and Kotri Dúns, and often cultivated. Flowers in autumn; flowers of a deep rose colour; yields a gum. *B. Malabarica*, Roxb., 345, Brandis, 159, the *amli* of these provinces and *amlosa* of Oudh. *B. racemosa*, Lam. Brandis, 159; *B. parviflora*, Roxb., 345, the *kachndál*, *guriál* and *thaur* of the North-Western Provinces, and the *ashta*, *makkúna* of Oudh, also yields a gum, but good specimens are wanted and might easily be procured.

Borassus flabelliformis, Linn. The *tár* or *tári* of these provinces, cultivated as far north as Sa'áranpur, yields a black gum, having a black and shining fracture. Brandis, 544; Cooke, 10; Roxb., 721.

This gum has not yet been carefully examined.

Careya arborea, Roxb. The *kumbh* of Kumaon. Brandis, 236; Cooke, 12; Roxb., 447.

"A large tree, wholly glabrous, leaves alternate, approximate at ends of branches, obovate-oblong, membranous, sessile or narrowed into a short marginate petiole, crenate, with 10-12 pair of prominent main lateral nerves. Flowers large, sessile, a few together at the ends of branchlets, white and pink, with an unpleasant smell. Calyx wholly adnate, 4-cleft. Petals 4, spreading. Ovary 4-celled. Stamens very numerous, middle row antheriferous. Fruit globose, green, 3 inches across, crowned with the persistent calyx-segments. Seeds numerous."

It occurs in Oudh and along the sub-Himalayan tract as far west as the Jumna. It yields a greenish gum, regarding which but little is known.

Cassia Fistula, Linn. *Cathartocarpus Fistula*, Pers. Brandis, 164; Cooke, 12; Roxb., 343.

The well-known *amaltus*, *éimi*, *tola*, *kitola*, *shimarra*, *kitwóli* of the North-Western Provinces, *warga* of Oudh. A red juice exudes from the bark which hardens into a gum called *kamarkas*, which requires further examination.

Cedrela Toona, Roxb., the well-known *tín* or *mahanám* of these provinces. Brandis, 72; Cooke, 12; Roxb., 213; Hooker, 568.

It yields a resin rather than a gum, and regarding it further inquiries are necessary.

Sponia orientalis, Planch. *Celtis orientalis*, Linn. Found in Kumaon. Brandis, 430; Roxb., 262.

Said to yield a gum of the cherry-tree kind in Madras.

Anogeissus latifolia, Wallich. *Conocarpus latifolia*, Roxb. Brandis, 227; Cooke, 14; Roxb., 384. *Dháwa*, *dhawra*, *bákli*, H.

"A large tree with smooth white-grey bark; young trees with spinescent branches; branchlets and young leaves with soft silky pubescence. Leaves coriaceous, sub-opposite, on short petioles, oval or ovate, rarely ovate-lanceolate, obtuse retuse or emarginate, glabrous when full-grown; 2-4 inches long; main lateral nerves arching, 6-10 on either side of midrib. Flower-heads in short

axillary racemes; peduncles as long as flower-heads or shorter. Calyx 2-winged at base, prolonged above ovary into a 5-cleft tube, yellow. No petals. Stamens 10. Ovary 1-celled, 2-ovuled. Wings of fruit nearly orbicular, glabrous, persistent calyx-tube (beak) slightly pubescent, as long as or longer than the fruit."

Common throughout the Dún and Bhábar and in Bundelkhand. A sample of this gum from Madras is in more or less irregular tears adhering to fragments of bark, clear, transparent, pale honey-coloured, more or less brownish, tough and not friable, tasteless, for the great part soluble in water. A picked sample from the Central Provinces was in elongated cylindrical or vermiform tears, half an inch in diameter, sometimes three times as long, and curved, clear, transparent, pale horn-colour, or almost colourless, forming a clear colourless mucilage with cold water, but with a small proportion of bassorine swelling and not dissolving. The mucilage was quite colourless, as tenacious as ordinary gum-arabic, but must be poured off from the less soluble portion which sinks to the bottom. The four reports on an unpicked, ordinary sample of this gum were: (1) Inferior gum-arabic, much too drossy, very weak gum; it should be picked clean; sample of little value, probably 15s. per cwt: (2) arabic gattie gum, 22s. 6d. to 25s. per cwt.: (3) rather low gum of arabic or acacia kind, and partial solubility, value about 10s. per cwt.: (4) mucilaginous gum, very weak, and contains, say, 50 per cent. insoluble matter; the sample contains a large quantity of bark mixed with the gum; a clean sample might obtain, say, 15s. per cwt., but very unsaleable. Dr. Watson writes of this gum:—

"If the price quoted by the Officiating Deputy Conservator of Forests at Haidarabad as that for dowra gum—namely, £14 per ton—be accepted as the normal rate, then from £10 and upwards remains to pay freight and charges and secure a profit upon consignments to this country. This is the conclusion which the reports justify us in forming. It is worthy of notice that these samples of gums are not so good as they might have been had more care been exercised in their collection. All the samples are more or less drossy and mixed with pieces of bark. The gum itself is subject also to selection, since the separation of the brown from the white pieces would raise the value of the latter. The market value, it may fairly be presumed, would be augmented considerably by the gum being cleaner picked and the browner portion separated from the whiter, the latter only being exported." (See *Brandis*, p. 228.)

Odina Wodier, Roxb. *Brandis*, 123; *Cooke*, 21; *Roxb.*, 336. *Jhingan, jiban, sindan, kanni, karallu*, H.

"Young branches, leaves, and inflorescence with deciduous stellate tomentum. Leaves alternate, imparipinnate, few, near ends of branches, 12-18 inches long, more or less glabrous when old; leaflets opposite, entire, 3 or 4 pair, short-petiolulate, ovate, the terminal long-petiolulate. Flowers small, tetramerous, on short pedicels, in compact, few flowered, cymose fascicles, the female flowers in simple, the male flowers in compound racemes. Racemes numerous at the end of branches, or on short lateral branches, male and female on different branches (often on different

trees). Bracts numerous, broad-ovate, ciliate. Calyx-lobes obtuse, ciliate. Petals oblong, more than twice the length of calyx, coriaceous, spreading, purplish and greenish-yellow. Stamens 8, in male flowers as long as petals. Ovary 1-celled with 4 distinct short styles. Ovule solitary. Drupe on short pedicel, obliquely oblong, compressed, $\frac{1}{4}$ - $\frac{1}{2}$ inch long; epicarp coriaceous, glabrous, red when ripe. (Sometimes black?)

Common throughout the forests of the sub-Himalayan region. Roxburgh says the gum issues from wounds in the bark, and when dry is much like pieces of dry glue. Brandis notes that a yellowish-white gum exudes in spring which is largely collected and used in cloth-printing by dyers and in medicine. It is also used as an adhesive ingredient in whitewash and fine stucco, and for making ink. A white stalactitic variety, soluble in water, is not uncommon. Two kinds are found in Kumaon: the white (*kanne*) picked from the tree and sold at ten sers for the rupee, and the black (*jingan-ki-gond*) sold at fifteen sers for the rupee. The latter is what falls to the ground and is usually mixed with the gum of *Anogeisus latifolia* (*bakli*). Both are gathered in April. A man can gather about one ser of the white and five sers of the black per diem. A sample of *mohin* gum from Haidarabad, supposed to have been derived from this source, furnishes the following report: (1) Gum-arabic similar in character to *chironji*, but inferior and too low for this market: (2) arabic hoggy, mixed, 25s. to 30s. per cwt.: (3) similar to *chironji*, but more lumpy, about 10s. to 15s. per cwt.: (4) mucilaginous gum, containing a large quantity of viscid insoluble matter, thereby rendering it nearly useless, as it would be impossible to separate the soluble from the insoluble gum. If brought on the market, it would most probably be bought and shipped abroad for the purpose of adulteration. It has really little or no intrinsic value.

Elaeodendron glaucum, Hook. *E. Roxburghii*, Wet. A.; *Neerija dichotoma*, Roxb. Brandis, 82; Cooke, 16; Roxb., 217; Hooker, 623. *Bakra, shawriya, chawli, daberi, māmri* of North-Western Provinces.

"Leaves glabrous, generally opposite, on petioles $\frac{1}{2}$ inch to 1 inch long, elliptic, ovate or oblong, acuminate, crenate, coriaceous; stipules small, triangular, deciduous. Cymes axillary, dichotomous, spreading, as long as or shorter than leaves; peduncle longer than petiole; branches divaricate; bracts small, caducous. Flowers pentamerous. Calyx-segments broad, round, obtuse. Petals oblong with membranous edges, yellowish brown and white. Stamens shorter than petals; filaments recurved; anther-cells attached to a broad semi-circular connective, diverging at base. Disc thick, fleshy, angled. Style very short. Ovary usually 3-celled, cells 2-ovuled. Drupe ovoid or obovoid, $\frac{1}{2}$ inch long, yellowish green when ripe, thin, fleshy; putamen 1-celled, 1-seeded, crustaceous."

Common in the Siwālik tract, Bhābar, Bundelkhand, Oudh. The gum, known as the *jamrasi* gum in the Central Provinces, occurs in roundish tears of variable size, the majority not exceeding half an inch in diameter, externally finely rugose, and minutely cracked, with a shining fracture, rather brittle; some tears almost colourless, others dark reddish brown, with intermediate shades of amber and brown. Tasteless. Soluble in water, forming a tenacious mucilage of a sherry colour.

Feronia Elephantum, Correa. Brandis, 56; Cooke, 17, Roxb., 374; Hooker, 516. *Kattel, bilin, kait, kaitha*, H.

"Glabrous, armed with strong, straight, axillary thorns. Leaves alternate, imparipinnate. Leaflets 5-7, cuneate or obovate, crenate at the top. Flowers of a dull-reddish colour, in loose, lateral, or terminal leaf-bearing panicles, axis and branches pubescent, male and bisexual flowers frequently on the same panicle. Stamens 10-12. Fruit globose, 2½ inches diameter, 1-celled; rind hard, woody, outside rough, grey-coloured; seeds numerous, embedded in a fleshy, edible pulp."

Occurs in the Dúns and outer Himalayas. The gum is employed in making ink and varnish, by bricklayers in preparing certain plaster, and by dyers and painters. It occurs in irregular tears, semi-transparent and of a reddish brown colour, or, according to Brandis, white, transparent. Treated with water, it affords a brownish tasteless mucilage not less adhesive than gum-arabic. It is recommended as a good substitute for gum-arabic in medicinal preparations, and for this purpose is superior to gum babúl (Pharm., 62). From the reports already made it would appear that this gum deserves some further examination.

Woodfordia floribunda, Salisb. *Grislea tomentosa*, Roxb. Brandis, 238; Cooke, 18; Roxb., 317. *Dáwi, tháwi, dhái, dhaura, santha*, H.

"A large shrub, with long spreading branches, pubescent, young branchlets and leaves with numerous small black glands. Leaves opposite or sub-opposite, sometimes in whorls of 3, sessile, 2-4 inches long, quite entire, ovate-lanceolate from a cordate or rounded base, with 6-10 prominent arcuate lateral nerves on either side of midrib, joined by distinct intramarginal veins. Flowers on slender pedicels, dilated above, shorter than calyx, with a few bracts at base, in axillary clusters. Calyx tubular, scarlet, slightly curved and widened at mouth. Petals minute, rose coloured. Stamens 12, much exserted. Capsule 2-celled, 2-valved. Length of style and stamens varies in this plant, as noticed for *Lythrum Salicaria* in Oliver's Ind. Bot., 213."

Common all over these provinces. Balfour says the gum of this shrub is collected largely in Harauti and Mewar. One specimen from Allahabad appears in good strong tears. It appears to be of the nature of a tragacanth and swells in water.

Specimens of the gum from the following trees should be collected for examination:—

Page in				Scientific name.	Native name.
Hooker.	Roxburgh.	Cooke.	Brandis.		
516	590	13	55	Citrus decumana, ...	Chakotra, mahá ntbu, shaddock.
516	590	13	53	Citrus Aurantium, ...	Narangi, sangtara, kamla ntbu; orange, Kumaon.
514	590	14	51	Citrus medica, ...	Bijawra, bara ntbu, ntbu, mitha ntbu; lime, Kumaon.
...	723	16	553	Phoenix sylvestris, ...	Khajár or wild date palm, Kumaon.
...	684	16	454	Phyllanthus Emblica, ...	Aonla, amlika, dauila, aola, Kumaon.
...	541	17	189	Erythrina Indica, ...	Pangara, Indian coral-tree, Kumaon.

Page in				Scientific name.	Native name
Hooker.	Roxburgh.	Cooke.	Brandis.		
528	370	18	62	Garuga pinnata, ...	<i>Kharpat, kilmira, ka-tála, sarota, Kumaon.</i>
...	689	19	442	Jatropha Curcas, ...	<i>Safed ind, Kumaon.</i>
544	369	19	68	Melia Azedarach, ...	<i>Bakain, dreh, deikna, Kumaon.</i>
...	318	20	293	Mimusops Elengi, ...	<i>Maulsári, cultivated.</i>
...	318	20	291	Mimusops Indica, ...	<i>Khirmi, cultivated.</i>
...	655	20	408	Morus Indica, ...	<i>Tát, tátri, Kumaon.</i>
...	538	22	153	Pongamia glabra, ...	<i>Pápri, karanjh, kanji.</i>
...	361	22	169	Prosopis spicigera, ...	<i>Jhánd, khár, chawnkra.</i>
...	403	23	241	Punica Granatum, ...	<i>Anár, dárim, pomegranate, Kumaon.</i>
683	332	23	107	Sapindus detergens, ...	<i>Dodan, rtiha, kanmar; soap-nut.</i>
682	331	23	107	Sapindus emarginatus, ...	<i>Rtiha, cultivated; soap-nut.</i>
...	268	24	124	Semecarpus Anacardium,...	<i>Bhiláwa, bhála; marking-nut.</i>
567	370	24	71	Soymida febrifuga, ...	<i>Rohan, rohini, soymida, Mirzapur.</i>
...	387	24	128	Spondias Mangifera, ...	<i>Amra, ambodha; hog-plum.</i>
...	530	25	163	Tamarindus indica, ...	<i>Imli; tamarind.</i>
249	274	25	21	Tamarix dioica, ...	<i>Jháó, kachli, pilchi, kódn.</i>
249	274	...	22	Tamarix articulata, ...	<i>Faráá.</i>
...	382	26	224	Terminalia Arjuna, ...	<i>Arján, kaháa, kawa.</i>
...	388	27	225	T. tomentosa, ...	<i>Sain, asin, sáj.</i>
...	380	26	222	T. bellerica, ...	<i>Bahera.</i>
...	381	...	223	T. Chebula, ...	<i>Har, harara.</i>
...	243	28	324	Wrightia tinctora, ...	<i>Dhádi in Bánda; seeds are indarjan.</i>
632	204	29	86	Zizyphus Jujuba, ...	<i>Ber.</i>
633	204	28	85	Z. flexuosa, ...	<i>Stmli, bán, phitni.</i>
633	206	...	88	Z. nummularia, ...	<i>Jhárber.</i>
681	331	29	105	Schleichera trijuga, ...	<i>Kúsam, kusumbha.</i>

Prosopis spicigera or *jhánd* yields a small quantity of gum which is chiefly used for mixing with other gums. It occurs in nodules, highly friable, of a granular texture, opaque or pale yellow colour; the grains of which the nodule consists are each transparent; the centre of the nodule is more transparent and of a reddish colour, soluble in water, and of an acrid, sweet taste. *Tamarix dioica* or *farás* yields a gum occurring in nodules, highly friable, of a granular texture, colour opaque or a pale yellow, but the little grains of which the nodule consists are individually transparent; the centre of each nodule is more transparent and of a red colour; in taste it appears to be a mixture of bitter and sweet; soluble in water. Powell (I., 397).

The species of *zizyphus* known as *ber*, *jhárber*, and sometimes *badari*, yield a gum of the *stmli* kind, but of such dark colour and inferior quality as to render it unsaleable in the English markets at a remunerative price.

B.—PSEUDO-GUMS.

Insoluble in cold water, swelling and forming a pasty mass.

(a.)—PALE OR TRAGACANTH KIND.

True tragacanth gum is not found in India, but its place is supplied by the false tragacanth known as *katira*.

Cochlospermum Gossypium, De Can. *Bombax gossypinum*, Linn. Brandis, 17; Cooke, 29; Roxb., 515; Hooker, 190. *Kúmbi, gabdi*, H.

"A soft-wooded tree. Leaves alternate, large, near the ends of branches, on long thick petioles, palmately 5-lobed; lobes acuminate, grey-tomentose beneath; stipules linear, caducous. Flowers on terminal panicles, large, 3-4 inches across, bright yellow, rachis and pedicels covered with grey pubescence. Sepals 5, deciduous, broad, oval, unequal, covered with a grey silky down, margin white-ciliate. Petals 5, contorted in bud, spreading, obovate, emarginate or irregularly cleft, with numerous parallel veins. Stamens indefinite. Filaments filiform, shorter than petals; anthers linear, acuminate. Style 1. Placentes parietal. Fruit in bunches, capsules oval, nearly the size of a goose-egg, 5-valved, divided by incomplete dissepiments. Seeds numerous, covered with a soft silky woolly substance."

Common in sub-Himalayan region and Bundelkhand. The gum is known as *katira* and is used in medicine, and occurs in semi-transparent, white, striated pieces, very much twisted and contorted. Of its uses, Dr. Cooke writes:—"The uses to which this class of gum can be applied in Europe are very limited. They can only replace the commonest and coarsest of tragacanth, for which there is little demand, or be employed for adulteration at home or abroad, unless some new application could be recommended, either in the dressing of fabrics or in connexion with some other extended branch of manufacture." (See *Indian Pharm.*, 27, 25; *Birdwood*, 274.)

Sterculia urens, Roxb. Brandis, 33; Cooke, 30; Roxb., 507; Hooker, 355. *Gulu Kálu Káru*.

"A tree with white bark. Leaves on long petioles crowded at the ends of branches, tomentose beneath, nearly glabrous above, sinuately 5-lobed; lobes entire, acuminate, sinuses shallow. Stipules caducous. Flowers small, numerous, greenish yellow, on short pedicels, supported by linear bracts longer than the bud, and deciduous after flowering. Petals none. Panicles crowded, generally pyramidal, erect, every part covered with a glutinous yellow tomentum; a few bisexual mixed with a large number of male flowers. Gynophore shorter than calyx; filaments 10, alternately longer, united below into a thin sheath, which girds the gynophore. Fruit of 5 sessile radiating, ovate-lanceolate, hard, coriaceous carpels, 3 inches long, red (yellow?) when ripe, covered outside with many stiff bristles which sting like those of the cow-itch (*Mucuna*). Seeds oblong, dark chestnut-brown, from 3 to 6 in each carpel."

Common in the Tarái and along the foot of the hills, in Bundelkhand and Mirzapur. This tree also yields a gum *katira*. The gum, says O'Shaughnessy, which exudes spontaneously during the hot season, occurs in large light brown transparent tough masses. Immersed in water, they swell like a jelly, but do not dissolve but by protracted boiling. The solution is not adhesive, and is destitute of the thickness of solutions of ordinary gum. The uses of this gum

are very limited ; the want of adhesiveness renders it unsuitable for the arts, while its difficult solubility renders it inferior to most other gums for medicinal purposes. (Dispens.)

"From time to time samples of this gum have been sent over for valuation, but hitherto no use has been found for it, and consequently it has no appreciable value in the markets. The only purpose for which it has hitherto been considered available is as an adulterant of tragacanth gum, but hardly as a substitute. Some samples either of this or a very similar gum have appeared in the London and Liverpool markets, and sold at a low price as false tragacanth or hog gum. It is doubtful whether it can take any place in British commerce until, by experiment, some special application has been discovered for it. The uses of and trade in genuine tragacanth gum are exceedingly limited, and for the purposes to which that gum is applied the *katira* gums do not answer equally well."

A sample from Chanda was valued in 1873 in London. It was a good selected sample, as good as could be procured, destitute of all extraneous admixture, and yet of two brokers to whom it was submitted, one reported that its value was 20*s.* per cwt., and the other "no value." A previous sample from Haidarabad was submitted to two brokers and two gum merchants, with the following reports:—(1) Low quality of tragacanth or hog gum, partly insoluble, value probably about 30*s.* per cwt.; better to separate the pale from the brown coloured pieces: (2) tragacanth hog, large, 45*s.* per cwt.: (3) a gum of the same nature as hoggy tragacanth, but has never appeared in this market from India; might become saleable; value about 30*s.* per cwt.: (4) a gum of the tragacanth order, and very slightly, but quite insoluble. If imported, this, we think, would be used for adulteration. Of the two samples, the former (from Chanda) was cleaner picked and better than the latter (from Haidarabad), yet the report of the brokers was less favourable. This can only be accounted for on the supposition that low qualities of tragacanth gum were more in demand in the market at one period than at the other.

Saccopetalum tomentosum, Hook. fl. et Thom. *Uvaria tomentosa*, Roxb. Brandis, 7; Cooke, 31; Roxb., 456; Hooker, 88. *Karri* of Oudh and Taráíl.

"A large tree. Young shoots clothed with soft silky tomentum. Leaves elliptic or ovate-oblong, 6-12 inches long, on short petioles, barely $\frac{1}{2}$ inch long, pubescent beneath, nearly glabrous and somewhat rough above. Flowers greenish yellow with a broad streak of brown, in leaf-opposed or subterminal 2-4 flowered cymes, on short peduncles, $\frac{1}{2}$ - $\frac{3}{4}$ inch long. Pedicels slender, 2-3 inches long. Sepals 3. Petals 6 in two series, valvate. Sepals and outer petals nearly equal, lanceolate, $\frac{1}{2}$ inch long; inner petals ovate-oblong, obtuse, $\frac{3}{4}$ inch long. Flowers and pedicels clothed with soft silky down. Carpels purple, tomentose, 3 or more, globose, 1 inch diameter, 3-4 seeded, on stalks $\frac{1}{2}$ - $\frac{3}{4}$ inch long."

Occurs in Oudh and Gorakhpur. A gum said to be from this tree was sent for report to England in 1873.

The following trees, supposed to yield a gum of the false tragacanth kind, require further examination :—

Page of				Scientific name.	Vernacular name.
Hooker.	Brandis.	Cooke.	Roxburgh.		
355	32	32	510	<i>Sterculia villosa</i> ,	<i>Udiel</i> , Kumaon; <i>udér</i> , Oudh.
359	34	32	507	<i>Sterculia colorata</i> ,	<i>Bodula</i> , Kumaon; <i>samarri</i> , Oudh.

(b.)—OF THE DARK OR MORINGA KIND.

“In many respects,” says Cooke, “these gums resemble those of the previous section, except that they are darker in colour, often of a vinous-red or brownish purple or purplish black, and hence not possessed of any commercial value in the European market.” A mere list of the names of the gumniferous trees which at present are placed in this class will be sufficient for my present purpose.

Page in				Scientific name.	Vernacular name.
Hooker.	Roxburgh.	Brandis.	Cooke.		
...	360	129	33	<i>Moringa pterygosperma</i> , ...	<i>Sahajna</i> ; horse-radish tree.
...	493	351	33	<i>Stereospermum suaveolens</i> ,	<i>Páral</i> , <i>padiala</i> , <i>parur</i> .
518	386	58	33	<i>Ailanthus excelsa</i> , ...	<i>Árua</i> , cultivated.
349	514	31	35	<i>Bombax Malabaricum</i> , ...	<i>Semal</i> ; cotton-tree.

The *sahajna* yields one of the gums called *mocharas*, of a white to a reddish colour and used in medicine. The gummy exudation from the *semal* is also known as *mocharas*. It occurs in opaque light-brown, knotty pieces, inodorous, and of a strongly astringent taste, and contains a large proportion of gallic and tannic acids. It is used in medicine as an astringent.

C.—ASTRINGENT GUMS.

Dr. Cooke writes that “the substances grouped under this section are provisionally so placed, because custom has hitherto sanctioned their recognition as gums, but their properties, and the mode in which they are procured, strengthen the inference that they are wrongly placed. It appears that the same arguments which might be employed against the transference of such substances as gambir and catechu to the group of gums and resins would apply with almost equal force against the retention of kino and mochurrus, and similar astringent extracts or exudations, in that group.

Pterocarpus marsupium, Roxb. Brandis, 152; Cooke, 35; Roxb., 536. *Btja*, *btja edl*, *bia*, H.

“A large deciduous tree, with full foliage and dark-green, shining, alternate, imparipinnate leaves. Leaflets 5-7, alternate, coriaceous, elliptic, obtuse, emarginate or acuminate, with scattered

adpressed hairs on both sides when young ; glabrous, shining, when full-grown. Lateral nerves, numerous, arcuate, joined by prominent reticulate veins. Flowers white, with a tinge of yellow, papilionaceous, $\frac{1}{2}$ inch long, on short pedicels, in short lateral and terminal panicle racemes. Calyx, peduncles, and pedicels with scattered adpressed hairs. Stamens and petals inserted above the base of calyx. Claws shorter than petals, lamina of all petals broad, waved or curled. Stamens monadelphous, the tube divided deeply into two bundles. Ovary hairy. Pod angular, nearly orbicular, $1\frac{1}{2}$ -2 inches diameter. Style lateral."

This tree is found in Kumaon and Mirzapur, and yields a variety of kinos. Kennedy, as quoted by Cooke, states that the juice is extracted when the tree is in blossom, by making longitudinal incisions in the bark round the trunk of the tree, so as to let the gum ooze down into a receiver formed of a broad leaf so placed and fixed in the bark as to prevent the gum from falling on the ground. From the leaf it is made to run into a receptacle placed under the leaf to receive the gum. When this receptacle is filled it is removed ; the gum is dried in the sun until it crumbles, and then filled into wooden boxes for exportation. East India kino was analysed by Vanquelin, who found its constituents to be as follows :—"Tannin and peculiar extractive, 75 ; red gum, 24 ; and insoluble matter, 1. A. W. Buchner has subsequently shown that catechine is a constituent of kino. To this substance kino owes its power of communicating a green colour to the salts of iron." Roxburgh has the following note on this gum :—"From wounds in the bark there issues a red juice, which hardens in the open air into a dark red, very brittle, gummy resin ; on being powdered it changes to a light brown, not unlike powdered Peruvian bark. In the flame of a candle it burns with difficulty, and without cracking, swelling, noise, or any peculiar smell, into fine white ashes. In the mouth it melts away like the simple gums. Its taste is strongly but simply astringent ; as much so, I think, as that of the gum of the *Butea*, which it resembles much. It tinges the spittle but little ; heat does not soften it. It is readily and almost totally soluble in either water or spirit ; the solutions are a pretty deep, but dull red : the spirituous one was rather more transparent, yet with a martial solution it shows considerably less astringency than the watery solution. Here it differs from *Butea gum*, for the spirituous solution of that, although seemingly less perfect than this, shows rather more astringency with the chalybeate proof than the watery solution. The solutions bear being mixed without decomposition. Vinegar added to them makes no immediate change ; mineral acids debase their colour ; alkalis heighten them. In short, this substance is so exceedingly like the gum of the *Buteas* that one analysis may serve for both. The solutions, after being kept ten days, showed no signs of change, and the same experiments, were then repeated, with the same success. It is highly necessary to observe that the above analysis was made with the gum resin fresh from the tree (how long it had adhered thereto I cannot say) ; because I find that when the gum of *Butea frondosa* is kept one year or two, it is less soluble

in water than in spirit, and the watery solution grows sooner turbid, but at the same time this turbid solution continues, as when recent, to show with a martial solution more astringency than the spirituous."

Butea frondosa, Roxb. Brandis, 142; Cooke, 38; Roxb., 540. *Dhak, palds, chickra*; in Bundelkhand *chulcha, chit*.

"Young parts downy or tomentose with soft simple hairs. Stipules linear-lanceolate, stipels subulate, both tomentose and deciduous. Leaves infoliate. Leaflets opposite, stipulate, coriaceous, hard, clothed with adpressed hairs beneath and a few scattered hairs above, emarginate, or rounded at the top, the terminal broadly obovate from a cuneate base, generally as long as broad, 4-6 inches long, the lateral leaflets oblique-obovate, smaller; lateral nerves 4-8 on either side of midrib, joined by numerous prominent reticulate veins. Flowers large, orange-coloured, papilionaceous, fasciculate, in rigid racemes; pedicels twice the length of calyx. Branches of inflorescence, bracts, and calyx densely clothed with soft ferruginous hairs. Upper stamens free, nine connate beyond the middle. Style long, curved. Legumes pendulous, tomentose, 4-6 inches long, 1½-2 inches broad. Seed oval, flat, smooth, brown, 1¼ inch long, 1 inch broad."

This tree occurs in large tracts of jungle all over these provinces, and yields the Butea gum, a variety of kino known as *kamarkas* in the bazars. It occurs in the form of tears which, when fresh, are of a beautiful red colour, but when kept for any time they become opaque and darker in colour. The gum is largely employed in native medicine, and in European practice as a substitute for the true East Indian gum kino, the produce of *Pterocarpus marsupium*, noted above. Butea kino dissolves readily in water and partially in alcohol, and some specimens yield over 73 per cent. of tannin. The Dún exports yearly 27 maunds of this gum, which there pays a royalty of Re. 1-2 per maund. Professor Solly gives the following account of experiments made¹ by him on the tanning pro-

properties of Butea kino:—"It is of a brilliant ruby-red colour, transparent and very brittle, and consists principally of small round tears, and other fragments which from their form appear to have been detached from the lesser branches of the tree. When it has been kept for some time it becomes opaque and dark coloured; this, however, may be prevented, according to Dr. Roxburgh, by preserving it in well-closed bottles. When exposed to heat the kino swells up, emits fumes which are partially inflammable and then ignites; if after that it is removed from the source of heat, it continues to glow like tinder, until nearly wholly consumed, a very small portion of a white ash only remaining. Ten grains of the kino, carefully selected as to purity, were ignited in a covered platinum vessel, and retained at a red heat until all the carbonaceous matters were burnt; there then remained 0.45 grains of white ash, a very small portion of which was soluble in acids with effervescence, the remainder consisted principally of silica and alumina. It swells and slowly dissolves in the mouth, having a pure strong astringent taste, like the finer kinds of catechu. It has no smell. In cold water it swells, and slowly imparts to it its

¹ Journ. Agri.-Hort. Soc., Cal., VII., 26.

fine red colour ; after some time only the outer portions of the kino remain which by exposure to the air had become dark coloured and almost insoluble in water, whilst the whole of the interior and unaltered kino is dissolved. These insoluble portions consist principally of difficultly soluble extractive. A sufficient quantity of boiling water dissolves the whole, and on slowly evaporating the solution, the difficultly soluble extractive separates in tough red films. The quantity of this extractive of course varies considerably in the two specimens, and influences their solubility.

“ Both alcohol and pyroligneous spirit dissolve a considerable portion of the Butea kino, but far less than water. Ether dissolves but little and remains colourless ; when a portion of ether is agitated with a strong aqueous solution it soon becomes thick, and, on evaporation, yields a considerable portion of tannin.

A small quantity of persulphate of iron changes the colour of the aqueous solution to a dirty green ; a rather larger quantity occasions a copious green precipitate. A series of experiments were made on the effects of various re-agents on solutions of this kino, with a view to ascertain which were the best precipitates of the red colour, either for dyeing or as a pigment. Solutions of most acids and acid salts changed the colours to a light orange, and for the most part occasioned copious precipitates ; they were nearly all of a dirty yellow or orange colour. When a few drops of a strong solution of caustic potassa were added to the aqueous solution of the kino, the colour was immediately altered and very much improved, becoming of the most splendid crimson ; when, however, a little more of the solution of potassa was added, the colour rapidly became gray, and a copious precipitate fell. It very quickly became dark reddish gray and nearly the whole of the colour was destroyed. Caustic soda and ammonia likewise improved the colour in the same way. When acids were added to solutions thus precipitated so as just to neutralise the alkali, some of the precipitate redissolved and the rest became orange. Carbonates of potassa and soda both very much deepened the colour of the solution ; it was however not to be compared in beauty of colour with the solution obtained by the addition of a small quantity of caustic potassa, and had a slight brown tinge. In general, most saline solutions occasioned precipitates which were either pink, gray, or colours between the two. Acetate of lead, as well as several other metallic solutions, precipitated the whole of the colouring matter. The precipitate obtained by adding a solution of alum either to a neutral solution, or to one containing a small quantity of alkali, was of a dirty pink colour. When gelatinous or recently precipitated alumina was agitated with any of the highly coloured solutions, it soon abstracted all the colouring matter, but the lake so formed was, like those formed by precipitation, of a dingy colour. The precipitates formed by metallic solutions were of very variable hues, but in no case were the colours

so obtained decided or brilliant. Attempts were likewise made to fix the colour in the fibre of cotton, silk, wool, &c., in various ways, and with different mordants, the colours were all imperfect, dingy, and variable in colour, but they were very permanent. This agrees with the results obtained by Dr. Roxburgh, but as his experiments were made on the fresh substance, they were under more favourable circumstances. The cause why these colours cannot be well employed is, that the red colouring matter is so intimately combined with the tannin and gum, that whenever the one is precipitated, it carries down the other also : and hence, when we endeavour to precipitate the tannin alone, the red colour or extractive is always precipitated with it ; this, as will presently appear, is in some cases a great inconvenience. A solution of gelatine produced in aqueous solutions of the Butea kino an abundant precipitate of tanno-gelatine, which always contained a portion of colouring matter.

“ The solution, after the separation of the precipitate, contained gum, extractive, gallic acid and minute portions of other matters ; the quantity of gallic acid was very various, but in no case did it appear to exist in any considerable proportion. One hundred parts of the rough kino were dried for six hours at a temperature of about 130° Fahrenheit ; they lost 13·23 parts of water. Much of this water was derived from the wood, bark, and impurities, for the pure substance when separated was far less hygrometric. The kino thus dried was digested in water kept nearly at the boiling point, until a strong solution was made ; this was then poured off, and the process repeated with fresh portions of water until all the matters soluble in that fluid had been thus removed. The residual matters, consisting only of impurities, weighed 17 parts. The solutions were then rapidly evaporated to a considerable degree of concentration, during which 3·5 parts of difficultly soluble extractive fell down. It was necessary to complete this evaporation as rapidly as possible, because, if the hot solution was long exposed to the air, it became much darker coloured and was somewhat altered in properties. The solution was then precipitated by a strong solution of gelatine, of which 28·3 parts were employed. The precipitate, when collected, washed, and carefully dried, weighed 79 parts ; by subtracting from this the weight of the gelatine employed, the proportion of matter precipitable by animal jelly is ascertained to be 50·7. This was of course principally tannin, but it contained a portion of coloured extractive which gave to it a dark colour, varying in depth with the circumstances under which the solution was made, &c. The remainder of the solution, after the separation of the tannin, was evaporated ; it contained gum, a small quantity of gallic acid, extractive, and minute traces of saline and earthy matters, weighing in all 15 parts. If the substance were to be employed in the arts, it would be very probably most convenient to obtain it as an extract, unless by so doing it became much darker in colour. By dissolving the tannin by cold water, extracts have been obtained in which the percent-

age of tannin was as high as 75°, and sometimes even higher ; but these extracts were made under the most favourable circumstances, being prepared with rapidity and the least possible exposure to the air. It would be utterly impossible to manufacture the extract in the large way in this manner, even if the causes above mentioned do not prevent it, but it might very probably be advantageous to prepare the kino of the *Butea* as an extract, as the cost of freight would be therefore less. From the large percentage of tannin which this substance contains, as indicated by the above experiments, and from its probable cheapness, it promises to be of considerable value in the arts, and especially in that of tanning leather.

“As a substitute for the astringent substance now in use, its adoption in many cases from convenience or economy is self-evident, and requires no comments ; but in the art of tanning leather so many points require to be considered that it is necessary to say a few words on that subject. On putting a piece of felt or prepared skin into a strong solution, it soon absorbs a considerable quantity of tannin, but at the same time becomes of a rather dark colour ; this is an unfortunate quality, because, as the consumers of leather judge of its quality in part from its colour, the tanners do not like employing anything which deepens the colour too much. The colour taken up by the leather of course varied with the solution employed, a cold solution of the kino giving a much lighter-coloured leather than a hot-made solution. The leather tanned with this kino is very hard and rather brittle, but it was tanned with considerable rapidity. These results were obtained on small pieces of thin skin, and it was not found to answer at all for tanning purposes ; its richness in tannin, however, promises well for tanning thick hides.”

The following is a report by Mr. Teil of the Kidderpore tannery on an experi-

Mr. Teil's experiment	ment made by him with a piece of <i>Butea</i> kino from Eta
in tanning.	in these provinces:—

“A piece of small calf-skin, after being prepared in the usual way for the reception of tanning, was on the 15th July immersed in a decoction of the ‘*dhák palás*,’ which was found readily soluble in cold water ; the decoction was changed at intervals, as is usual, four times, each succession of liquor being increased in strength to that which preceded it ; each liquor was found to darken in colour in proportion to the time it was exposed to the action of the atmosphere. The skin during the process was constantly worked and attended to, and would, with like care, have been thoroughly tanned in five days with babúl bark. On the 21st July a piece of the skin was cut to dry out, to see if it really was tanned, and although it was highly coloured through, and had all the appearance of being thoroughly tanned, yet after being well washed, as is usual in currying, and dried out, it became as hard and as impliable as a raw skin. Although it was highly coloured through, little or no tannin had combined with the skin.

The tanning process was continued, adding gradually as was required more of the substance until the 1st August, when another piece of the skin was tried by drying out, and with the same result as the first. From thence to the 15th and 25th August respectively, when the whole two sers was consumed, the remainder of the skin was finally dried out, and found to be scarcely one-third tanned. It is therefore said to be of no use as a tanning substance ; but it might perhaps be worthy of attention as a dyeing substance (for its colour seems very fast), or for tanning, could its astringent qualities, which are considerable, be easily deprived of so much colouring and gummy matters."

Dr. Roxburgh (p. 540), in a note on *Butea frondosa*, says :—"From natural fissures and wounds made in the bark of this tree, during the hot season, there issues a most beautiful red juice, which soon hardens into a ruby-coloured, brittle, astringent gum ; but it soon loses its beautiful colour if exposed to the air. To preserve the colour, it must be gathered as soon as it becomes hard and kept closely corked up in a bottle. This gum held in the flame of a candle swells and burns away slowly without smell or the least flame into a coal, and then into fine light white ashes. Held in the mouth it soon dissolves ; its taste is strongly but simply astringent. Heat does not soften it, but rather renders it more brittle. Pure water dissolves it perfectly ; the solution is of a deep, clear red colour. It is in a great measure soluble in spirits, but this solution is paler and a little turbid ; the watery solution also becomes turbid when spirit is added, and the spirituous more clear by the addition of water ; diluted vitriolic acid renders both solutions turbid and caustic ; vegetable alkali changes the colour of the watery solution to a clean deep, fiery blood red. The spirituous it also deepens, but in a less degree. Sal martis changes the watery solution into a good durable ink. These are, I think, proofs that a very small proportion of resin is present in this substance. In this it differs essentially from the gum-resin called kino or gummi rubrum astringens gambiense, which the Edinburgh college has taken into their *Materia Medica* ; but, as this can be most perfectly dissolved in watery menstruum, it may prove of use where a spirituous solution of the former, being the most complete, cannot be so properly administered : consequently it may prove a valuable acquisition also. I have used the recent gum in making my experiments, which may make some difference."

Butea superba (Cooke, 39 ; Brandis, 143 ; Roxb., 541) a gigantic climber found in Dehra Dún with membranous acuminate leaflets and flowers larger than those of the *palás*, of a gorgeous orange colour, on pedicels three times the length of the calyx, in lax paniculate racemes, is said by Roxburgh to yield a kino, as well as another climber, *Spatholobus Roxburghii* (the *B. parviflora* of Roxburgh) a large climber, which may be known by its small whitish flowers, and occurs in Oudh and the sub-Himalayan forests as far as the Jumna. Dr. Birdwood says

that *Sesbania grandiflora* (Brandis, 137; Cooke, 39; Roxb., 569), the *basna* and *baka* of these provinces, yields a kino-like gum.

We next come to the preparations known generically as *mocharas*. Powell says¹ :—"Some difficulty exists respecting the drugs

Mocharas.

which have been sent under the name of *mocharas*.

Many of them consist of a resin of a light red colour which has been attributed to the *Bombax Malabaricum* (*semal*) ; others are more translucent and pinkish, and resemble to a great degree the resin of the *sahajna* (*Moringa pterygosperma*), while a third set are more similar in structure to an excrescence, having apparently an epidermis. Further inquiry is necessary to ascertain the exact relation of these apparent galls to the genuine gum-resin." He afterwards² identifies the last form with the galls of the *Areca Catechu* palm, so that *mocharas* in the Panjáb has three meanings: the gum of the *semal*, the gum of the *sahajna*, and the galls called *phúl supyári* of the areca palm. Birdwood says³ the Bombay *mocharas* is not the gum of the *Bombax Malabaricum*, but a kind of gall produced on the *Areca Catechu*; and says that *sahajna* yields a kind of gum exactly like *mocharas* received by him from Amritsar. The editors of the *Pharmacopœia of India*⁴ give the name *mocharas* to the astringent gummy exudation from the *semal*, and say that it occurs in opaque dark brown, knotty pieces, some presenting a remarkable gall-like appearance, inodorous, of a strongly astringent taste. Dr. Cooke remarks that the origin of *mocharas* is to this day involved in mystery. He writes:—"It is undoubtedly true that the irregular, inflated, usually hollow, dark brown excrescences very much resemble galls, but, on the other hand, we can learn of no trace of insect life having at any time been found in the interior, or any orifice of escape detected. Many pounds weight of *mochurrus* have been broken in search of traces of evidence that the structure is that of a gall, understanding by that term a vegetable abnormal growth produced under local irritation caused by insects of some order or other. They are not galls, but gall-like exudations, for there is every appearance of their having exuded, in a manner similar to gum, in a semi-fluid state, which Dr. Birdwood considers to be the fact. This being admitted both from evidence and probability, all that remains is to determine the tree, which Dr. Birdwood affirms to be *Areca Catechu*, and the great astringency of the exudation renders this determination exceedingly probable; whilst Dr. Birdwood affirms that he has himself gathered precisely identical excrescences from the *Areca Catechu*. It is probable that the name of *mochurrus* may be given to more than one substance, but that the *mochurrus* of bazars, especially in Southern and Western India, is the produce of *Areca Catechu*."

Ougeinia Dalbergioides, Benth.; *Dalbergia Oujeinensis* of Roxb.; *sandan*, *chandan*, North-Western Provinces; *shánjan* Oudh, yields by incision a kind of gum kino used medicinally for the same purposes as *Butea kino*: see Brandis, 146; Roxb., 532.

¹ Panjab products, I., 319.

² *Ibid*, 397.

Veg. Prod., Bom., 10, 275.

⁴ P. 36.

II.—GUM-RESINS.

These substances partake of the nature both of gums and resins.

A.—EMULSIVE GUM-RESINS.

To the class of emulsive gum-resins belongs the produce of the *Garcinia pictoria*, Roxb., 444, or *usára rewand* the *G. Morella* of Hooker (p. 264) which is known as gamboge and is used in medicine (Pharm., 30) and in the arts as a paint. Siam gamboge usually appears, in commerce, in cylindrical pieces or sticks into which it has been melted. Cooke (pp. 41—49) mentions ten species of *Garcinia*, none of which seems to occur in these provinces, so their description and bibliography is omitted.

B.—FETID GUM-RESINS.

“The fetid gum-resins are, for the most part, the produce of certain umbelliferous plants exuding in a milky juice from the wounded root, and drying by exposure to the atmosphere. They have a more or less fetid, alliaceous odour, which culminates in asafoetida, and is just recognizable in ammoniacum, passing through intermediate stages in sagapenum, galbanum, and opoponax. The history of some of them is obscure, and the locality of production doubtful, but none of them are veritable Indian products, being found only in Indian commerce as imports from other places.”

Narthex Asafoetida, Falc. The gum-resinous exudation, from this plant is the well-known *king*, the asafoetida of English writers, a native of Afghánistan and the Panjáb.

It is used in medicine, and is well known from its bitter acrid taste and fetid, alliaceous odour. For medicinal uses, see Pharm., 101, and for remarks on the plant, see Powell, *Punj. Prod.* I, 404; Birdwood, 41; Cooke, 50, who goes very fully into the bibliography of the drug, Roxb., 271.

Ferula Persica *kundal, sakbtaj*, H.

Said to be the origin of the gum sagapenum, the *kundal* of the bazars, but doubtful, (see Birdwood, 40). It is used in native and European medicines as an antispasmodic and emmenagogue. It is imported from Kábul and Persia. See Powell, *Punj. Prod.*, I, 403; Cooke, 54, 63. *F. orientalis* of Linnæus is said to be found in Sindh; Cooke, 59.

Dorema Ammoniacum, Don; *ushshak, kilyanis*. H.

A gum-resin exuding from this plant, a native of Persia, yields the gum-ammoniacum used in medicine (Pharm., 103). It occurs in tears or masses; the tears from two to eight lines in diameter, pale cinnamon brown, breaking into an opaque, smooth, shining, white surface: odour faint, taste bitter, acrid, nauseous. Triturated in water, it forms a milky emulsion. It readily softens with heat and gives out when burned a disagreeable pungent odour. See Birdwood, 40; Cooke, 57.

Opoponax Chironium, Koch. *Jamshir, gaushtir*, H.

This plant is a native of the Levant, and yields the gum-resin opoponax used in medicine. It occurs in small rounded tears, yellow outside and whitish yellow within; texture like wax; burns readily with a peculiar odour; taste very bitter; when dissolved in spirits or vinegar, or triturated with water, it forms a milky liquid, hence the name '*gau shir*' or 'cow's milk.' See further Powell, *Punj. Prod.*, I., 402; Birdwood, 42; Cooke, 62. The *Ferula hooshee* of Royle (Ill. p. 231) found in Bilúchistán, seems to yield an opoponax gum-resin; Cooke, p. 63.

Galbanum officinale. *Baréja, bāzād*, H.

This plant, a native of Syria, yields the galbanum of the *Materia Medica*, a gum-resin used in medicine. That most commonly found in India under the vernacular names would appear to be the produce of *Ferula galbaniflua*, Buhse, described in *Pharm.*, 104, as appearing in irregular tears about the size of a pea, usually agglutinated with masses of a greenish-yellow colour, translucent, having a strong disagreeable odour and an acrid bitter taste. See further Powell, *l. c.*, 404; Birdwood, 42; Cooke, 60. The origin of sarcocolla, another gum-resin (Cooke, 65), the *gūjar* of Bombay; *anzarūt*, Ar., and *kanzadah*, Pers., is unknown. *Gardenia lucida* and *G. gummiifera*, the *dikamāli* of Western Bundelkhand yield a valuable gum-resin of a dull, olive-green colour. See Brandis, 270, 271; Cooke, 66; Roxb., 237, 238.

Convolvulus Scammonia, scammony. *Sākmuniya*, H.

A gum-resin obtained by incision from the living root; is used in medicine: see *Pharm.*, 154. It occurs in irregular pieces of an ash-grey colour and rough externally; fresh fracture resinous, splintery, shining black when dry; odour and flavour cheesy. Imported through Bombay from Europe.

Euphorbia Canariensis. *Farfeyān, farbyān, afarbyān*, Arab.

This is the plant identified by Dr. Birdwood (77,) with the gum-resin of the bazars sold under the above name, and in Persian as *shir-i-dirakht-i-zakūm*. It is probable, as suggested by Mr. Powell, that the Indian drug must be referred to *E. antiquorum* Brandis, 438, Roxb, 392. The milky juice of this species is boiled down and used when mixed with oil as an application to water-tight cisterns, and instead of red-lead for steam-joints, and perhaps as a preservative coating for boats. Further, see Powell, *Punj. Prod.* I., 406.

Euphorbia Ligularia, Prickly pear, Eng. *tāer*, H. Brandis, 439; Roxb., 392.

Dr. Cheek of Cawnpore forwarded a specimen of the milky exudation obtained by incision to the Agri-Horticultural Society Committee, but it was found in its natural state unfit for use as a substitute for gutta-percha, but might be improved by chemical means.

C.—FRAGRANT GUM-RESINS.

This section includes those gum-resins which are not emulsive, and do not possess the fetid, alliaceous odour of the preceding.

a.—BDELLIUM KIND.

This subdivision includes gum-resins of some odour, of an aromatic, bitter taste, and usually of a darkish colour.

Balsamodendron Myrrha, Ehr., myrrh, *Bol.* H.

This tree yields the myrrh of Scripture: a gum-resin from Arabia. It occurs in irregular-shaped tears or nassess varying in size, somewhat translucent, of a reddish-yellow or reddish-brown colour; fractured surface, somewhat irregular and oily; odour agreeable and aromatic, taste acrid and bitter. Partly soluble in water, alcohol and ether; used in medicine: see Pharm, 51, Birdwood, 20. Inferior *bol* is called *baisa bol* in Bombay. *B. Opobalsamum* from Arabia yields the balm of Gilead: see Birdwood, 21; Cooke, 67.

Balsamodendron Mukul, Hooker. *Gágál, mukál, raughan táró, H.*

This tree, a native of Sindh, yields the Indian bdellium. It occurs in roundish pieces, somewhat softer than myrrh, of a golden brown or dull dark-red colour, not brittle; taste somewhat acrid and bitter, but not so bitter as myrrh; burns readily, with a slight pleasant odour. Its medicinal properties resemble myrrh: see Pharm., 51, 53. The gum-resin of *Juniperus religiosa*, Royle, is also called *gágál*; see Birdwood, 21; Brandis, 64; Hooker, 529; Cooke, 72. *B. Roxburghii*, Arn., found in Silhat and Assam, yields a similar gum-resin: Cooke, 71; Hooker, 529; Roxb., 320. *B. pubescens*, Stocks, from Sindh, yields an inferior gum: Cooke, 74; Brandis, 65; Hooker, 529. The gum-resin of the mango or *ám* (*Mangifera Indica*) is classed amongst the fragrant resins of the bdellium kind: Cooke, 74; Brandis, 125; Roxb., 215.

(b).—BENZOIN KIND.

This subdivision includes such gum-resins as are characterized by the presence of benzoic acid, or which may be used as incense; as gum benzoin and gum olibanum.

Styrax Benzoin, Dryand. *Lubán, H.*

This tree yields benzoin, gum benzoin or benjamin, the *lubán* or *úd* of the bazars. It comes from Sumatra and Siam and is produced by incisions into the bark. It occurs in lumps, consisting of small masses of tears, or of a brownish mass with or without tears; has little taste and an agreeable odour; is soluble in rectified spirit and in solution of potash. It contains 76 to 80 per cent. of resin, a volatile oil and an acid known as benzoic acid. The whitish varieties are best for medicinal purposes. It is used in medicine, and as an incense by Roman Catholics, Buddhists and Hindús in their worship. It is also commonly burned as a disinfectant and to ward off mosquitoes and sand-flies. See, further, Cooke, 75; Roxb., 375. *Terminalia angustifolia*, W. et A., is noted by Royle as producing a gum-resin in some respects resembling benzoin. It is composed of large white and brown pieces, easily broken by the hand, and when gently dried

forms a white powder, which has an agreeable scent, and was formerly in much use for incense and as a cosmetic: Cooke, 78; Roxb. 382.

Boswellia Thurifera. Serli, H.

This tree, found on the Coromandel Coast along the Base of the Himálayas, and in Western Bundelkhand, is supposed to produce the gum-resin known as *kundras* or *kundar*, the Indian olibanum or frankincense (*Pharm.*, 52.) It is, however, the source only of the stalactitic variety according to Colebrooke. The more common olibanum is procured from the Somali coast westward of Cape Guardafui. It occurs in the form of round, oblong or ovate tears, semi-opaque, fragile, of a pale yellowish colour, pungent, slightly aromatic taste and balsamic resinous odour, and becomes opaque when immersed in alcohol. For uses and preparations in medicine, see *Pharm.*, 52, 443. It is produced from the *B. papyrifera*: see Birdwood, 22 to 24, 280 to 282. For further information on this subject see Powell's *Punj. Prod.*, I, 399 to 402. The Coromandel olibanum gives on analysis—volatile oil, 8·0; resin, 56·0; gum, 30·0; a gum-like substance insoluble in water and alcohol, 5·2 (*As. Res.*, IX., 377). It is also known as *ganda biroza*, (the name properly applied to the resin of *Pinus longifolia*) and *salai*. *Pime/a* (*Boswellia*) *glabra* also yields a portion of the Indian olibanum. See, further, Cooke, 79-84; Brandis, 61; Roxb., 365; Hooker., 528.

Calamus Draco, *Dam-ul-akhwain*, *jaida rámi*, *hirda khán*, H. Roxb., 719.

This climber yields the dragon's blood of the Indian Materia Medica; it is a native of the Indian Archipelago. *Pterocarpus Draco* of Socotra and America yields the dragon's blood of Europe (Birdwood, 30). It occurs in irregular pieces of a fine red colour, which ground up form the basis of a colouring matter. A fairly full account of this drug, which, as Cooke observes, bears the same resemblance to gum-resins that kinos do to gums, is given by him at p. 85 of his report.

III.—TRUE RESINS.

A.—COPALLINE RESINS.

In this group, Dr. Cooke includes all those resins like copal, dammer and animé, which are readily soluble in turpentine, forming a clear tenacious fluid, applicable as a varnish, and which might be called "varnish-resins."

Vateria Indica, Linn. *Kahruba* or *sandras*, H.

Yields the resin known as the peinei or piney dammar. It is procured by cutting a notch in the tree, sloping inwards and downwards, from which the resinous juice runs and becomes hardened by the air. It is often substituted for amber as an ornament or amulet. It is sometimes burned as a candle, giving off a pleasant smell and but little smoke. Six parts of

resin and one of camphor added to hot alcohol give a good spirit varnish for pictures, maps, and anatomical preparations, if the camphor be evaporated before use and the paper be prepared with a thin size of rice-water. Good clear lumps are used, boiled with linseed-oil, as a varnish for furniture and carriages. Specimens vary much in colour, denseness and fragrance : some are of a light greenish colour, dense, homogeneous, and vitreous on fracture, while others are yellow-amber coloured and vesicular. With the aid of heat and the addition of a small portion of camphor gum animé is soluble in spirit. With the aid of heat it also combines with wax and oil to form a resinous ointment. The resin used in medicine as *sandras* is either the produce of *V. Indica* or the Zanzibar copal imported through Bombay. See Birdwood, 276 ; Cooke, 87 ; Hooker, 313 ; Roxb., 436. *Vatica acuminata* (Hooker, 313), *Vatica lancefolia* (Hooker, 302 ; Roxb., 435), and *V. Roxburghiana* (Hooker, 302) are all mentioned by Cooke as affording true resins (pp. 89, 90).

The source of the true copal of the eastern coast of Africa is not known. It is obtained at Zanzibar under the names of *sandras-i-zamiti* and *chakázi*. The latter is either picked from the tree or found lightly embedded in the soil, where it has not remained long enough to produce bitumenization ; the former is the product of vast extinct forests and is completely bitumenized, resembling amber. (See Birdwood, 284.)

Shorea robusta, Gärtner. The *sál* tree. *Sál*, *sákhá*, N.-W. Prov. ; *sarye*, *sarei*, *ráñjal gágál*, Cen. Prov. ; *koro*, Oudh. Brandis, 26 ; Cooke, 90 ; Hooker, 306 ; Roxb., 440.

" A large tree, young branches, petioles, young leaves and inflorescence hoary or pubescent. Leaves glabrate, shining when full grown, 4-8 inches long, petiolate, broad-ovate, from a rounded or cordate base, entire, more or less acuminate, ending in an obtuse-point ; stipules caducous. Flowers yellowish, shortly pedicellate, in unilateral racemes, arranged in long, compound axillary panicles ; inflorescence, calyx, and outside of petals clothed with soft grey pubescence. Segments of calyx enlarged in fruit into 5 unequal, obtuse, oblong or spatulate wings 3-4 inches long, contracted above the base, brown, with 10-15 parallel longitudinal veins and fine reticulation between. Petals (at the time of flowering) 4 times the length of calyx, orange inside. Stamens 25-30 or more, anthers pilose at the apex, overtopped by connective ; style subulate. Ovary 3-celled, 2 ovules in each cell. Fruit ovoid, acuminate, $\frac{1}{2}$ inch long, hoary, coriaceous, indehiscent. The resin is known as *sál-ki-rá dhána rál*, and in Gorakhpur, *karail*."

The tree is common in the sub-Himálayan forests, in Gorakhpur and a portion of Southern Mirzapur. The resin constitutes one of the common dammars of the bazar, and occurs in small rough pieces from a pale creamy colour to a dark brown, nearly opaque, and very brittle. Each piece has a striated appearance as if composed of several layers (see Birdwood, 276). It is devoid of taste and smell, sparingly soluble in alcohol, almost entirely so in ether, and perfectly so in turpentine and the fixed oils. The superior kinds are sufficient substitutes for pine resins in medicine (see DRUGS). A report has recently been made on some specimens sent to England, from which it would appear that *sál* dammar would scarcely repay the carriage and expenses. One broker calls it a low

crusty copal, resinous and drossy, worth about 15s. per cwt.; another gives the value at 5s., and a third considers it similar to Manilla copal, worth about 18s. per cwt. (*Suppl. Gazette of India*, Feb. 15th, 1873). Dr. Watson writes of this and a similar resin :—"The two resins are of a very low quality, and that of the *sál* would scarcely pay to export to this country. The *thingan* from *Hopea odorata* is small and valued at from 20s. to 40s. per cwt. Its nearest allies in the London market are common Manilla and Lisbon copal, the values of which respectively are about 28s. and 37s. per cwt. The market value of this resin in British Burma is stated to be about 4d. per lb. If so, it would be useless to send it to this country to compete with Manilla copal, 3d., and Lisbon copal at 4d. per lb." (See, further, Cooke, p. 90). The average selling-price during 1869-72 was Rs. 10 per maund in the forest-marts under Kumaon and in Pilibhit. It is chiefly used as a substitute for dammar by boat-builders, but even with them pine-resins are daily coming into use. Recourse is had to notching to obtain the resin of the *sál*, as without it the produce is of little importance. On this account the gathering of the resin has been prohibited wherever the *sál* forests are conserved, and as the operations of the Forest Department now extend over all the considerable forests in these provinces, the supply of *sál* resin in sufficient quantities to form an article of commerce may be looked upon as improbable.

Pistacia Lentiscus ; see Daves.

This tree, a native of the Mediterranean countries, yields the gum mastic of commerce, *musták-i-rúmi* and *kundar rúmi* of the bazars. It occurs in small brittle tears of a pale yellow colour, fragrant when heated. This substance is used in medicine and as a varnish in the arts. It contains a minute portion of volatile oil, about 90 per cent. of a resin soluble in alcohol, and about 10 per cent. of a resin (masticine) insoluble in cold, soluble in hot alcohol. *P. Khanjak*, Stocks, and *P. Cabulica*, Stocks, found in Sindh, yield the Indian substitute for the European gum : Pharm., 59 ; Cooke, 104 ; Brandis, 123.

B.—ELEMI OR SOFT RESINS.

Most of the resins in this sub-division are "so soft and clammy to the touch as to form a very natural link between the resins of a copalline character and the oleo-resins, which latter, by parting with much of their volatile oil by exposure, will sometimes become almost solid. Some of the elemi resins are wholly, and others in great part, soluble in rectified spirits. In many instances there is a decided, but not unpleasant, odour. No resin of this group, produced in India, is of commercial importance, the so-called Indian elemi being derived from Manilla, although the supposed tree has been introduced into India. The home of elemi-producing trees is more especially the tropical and sub-

tropical regions of the new world." Amongst them are included the following (Cooke, 108-110) Indian elemi:—

Page of			Scientific name.	Popular name.
Roxburgh.	Hooker.	Brandis.		
437	273	...	<i>Calophyllum inophyllum</i> , ...	<i>Sultani champa, sarpanka.</i>
504	531	...	<i>Canarium commune</i> , ...	<i>Jangli badén.</i>
...	518	58	<i>Ailanthus Malabarica</i> , ...	...
354	...	165	<i>Cassia auriculata</i> , ...	<i>Tarwar.</i>

IV.—OLEO-RESINS.

Under this group Dr. Cooke gives three heads: (1) balsams; (2) natural varnishes or lacquers, and (3) turpentine and tar.

(1.)—BALSAMS.

Balsams, as understood by Dr. Cooke, are somewhat different from what is ordinarily understood by the term. "A restricted application of the word 'balsam' was formerly in vogue under which the product so classed was described as containing benzoic acid. This definition is not accepted here; on the contrary, all oleo-resins (with the exception of the acrid lacquers, or natural varnishes, and the turpentine series) are grouped together under this section. The majority of Indian balsams approximate rather to the balsam of copaiba type than to that of balsam of Peru. The latter might be accepted perhaps as the type of true balsams, and the former of pseudo-balsams, but this sub-division need not be insisted on here."

Amongst the balsams may be mentioned the following:—

Page of				Scientific name.	Native name.
Roxburgh.	Hooker.	Brandis.	Cooke.		
321	529	66	112	<i>Balsamodendron berryi</i> , ...	<i>balsam-ki-tel</i> , the balm of scripture.
439	295	...	113	<i>Dipterocarpus turbinatus</i> , ...	<i>Gurjan-ki-tel</i> ; wood oil.
439	298	...	114	" <i>incanus</i> , ...	Ditto.
439	298	...	114	" <i>alatus</i> , ...	Ditto.
440	297	...	115	" <i>tuberculatus</i> , ..	Ditto.
570	509	74	115	<i>Chloroxylon Swietenia</i> , ...	<i>Bhirra, girya</i> ; satin-wood.
440	...	...	115	<i>Dryobalanops Camphoca</i> , ...	<i>Kafur</i> ; camphor.
578	...	...	116	<i>Hardwickia pinnata</i> , ...	...
...	...	...	116	<i>Liquidambar Altingia</i> , ...	<i>Asli lubén, saldras.</i>
...	...	...	117	" <i>orientale</i> , ...	Ditto.
591	...	...	118	<i>Melaleuca minor</i> , ...	<i>Kaipati-ki-tel.</i>
437	277	...	119	<i>Mesua ferrea</i> , ...	<i>Nághesar.</i>

(2.)—NATURAL VARNISHES.

Cooke makes the Burmese lacquer, *theet-tee*, the type of this class. Substances mostly of an acrid nature exuded by species of *Rhus*, *Semecarpus*, and their

botanical allies occur in most warm countries. Amongst the varnish-producing trees may be mentioned the following:—

Roxburgh.	Cooke.	Scientific name.	Native name.
267	120 121	Melanorrhæa usitatissima, ... Holigarna longifolia, ...	Khien. Halgiri.

Semecarpus Anacardium, Linn., marking-nut tree. Brandis, 124; Cook, 122; Roxb., 268. *Bhilawa*, H.

"A tree having the young branches, inflorescence, petioles, and underside of leaves clothed with a short, somewhat harsh, tomentum of simple hairs. Leaves alternate, simple, coriaceous, approximate near extremities of branches, oblong-ovate, 9-18 inches long, rounded at the top, with rounded or cordate base, on a short, thick, half-round petiole. Flowers 5-merous, male only on some trees, nearly sessile, fasciculate, the fascicles arranged in erect compound terminal panicles. Bracts lanceolate, the lower branches of panicle in the axils of leaves. Petals oblong, 3-4 times the length of calyx, spreading, glabrous, greenish yellow. Filaments subulate from a somewhat dilated base. Styles 3, ovule, solitary. Drupe obliquely oval or oblong, about 1 inch long, smooth, shining, purplish black when ripe, hypocarp orange."

Common all along the sub-Himalayan region. The average yearly export of the seeds from 1869 to 1872 from the Dún forests was 25 maunds, paying a royalty of four annas per maund; from Kumaon and Garhwál about 100 maunds are exported. The price per maund at the forest bazars under Kumaon averaged one rupee; at Najibabad, 13 seers per rupee is quoted as the average price for the same period.

Brandis notes that "the pericarp is full of an acrid juice which is used in native medicine. A black varnish is made from it, and mixed with lime-water it is used for marking cotton." Birdwood says it is the original of the black varnish of Silhat. *S. Travancorica* Beddome (Cooke, 122;) abounds with the same caustic black juice. *Odina Wodier*, noticed before (p. 14) for its gum, is said to yield a varnish, but this statement requires confirmation. *Buchanania latifolia*, the *kathbhilawa*, *pidl*, *muriya*, of Garhwál and Kumaon, should also be examined with reference to this class of products, and to this may be added the varnishes said to be derived from *Rhus succedanea* (Cooke, 123; Brandis, 121; Roxb., 273), the *tatri*, *arkol*, *arkhar*, *titar*, *lakhar* or *rtkhul*, and the *R. vernicifera* (Cooke, 124; Brandis, 120), *akoriya*, *kaunki*, *bhaliún* of Kumaon. These trees occur in Kumaon and Garhwál, and the former is identical with one of the Japanese varnish-producing trees. Both of these trees should be examined with reference to these remarks.

(3.)—TURPENTINE AND TAR.

Under this heading Dr. Cooke includes the resinous products of coniferous trees, "which are at first semi-fluid, although ultimately some of them become by evaporation of their more volatile elements firm and solid. Allied substances,

such as resin and tar, which are the results of distillation, are included." Kumaon, Garhwál and Jaunsár Báwar possess an almost inexhaustible supply of coniferous trees, from which large quantities of turpentine, the *ganda birozah*, *firozah*, *biroja* of the hills, and *dhúp* of the plains and Oudh are extracted. From this are produced resin and rectified oil of turpentine. Tar, too, is occasionally made, but not to any great extent, in the Kumaon Division.

Pinus Longifolia, Roxb. Madden, J. Agri-Hort. Soc. Cal., VII, 75. Brandis, 506; Cooke, 125; Roxb., 577.

The long-leaved pine. *Chitr* (in Sanskrit "*kishtra*," or "milk"), *sula* (Sansk. *saral*, "straight") in Kumaon; *kolon*, *kolan*, *kolain* in Garhwál; *saral* in Jaunsár; *thansa* above the Dún the *dhúp* of Oudh. To the west of Garhwál the term *chitr* is applied to *P. excelsa*.

"A large tree, with symmetrical branches high up on the trunk forming a rounded head of light foliage. Bark rough, cut into polygonal plates by deep dark-coloured furrows. Leaves in clusters of three, 9-12 inches long, sometimes longer, slender; inner face keeled, so as to be nearly triquetrous, with a rounded convex back. Sheath persistent, grayish brown, of numerous closely imbricate bracts, fimbriate at the edges with long fibres. Cones on short stiff stalks, spreading or recurved, solitary or in whorls of 3-5; ovoid conical, 4-7 inches long, 3 inches diameter above the base. Scales 1½-2 inches long, ¾ inch broad, and ½ inch thick at the top, the apex (apophysis) forming a spreading or recurved obtuse pyramidal beak, with 4-6 more or less distinct rounded faces. Seeds with a thin membranous wing ½-1 inch long, obtuse, oblanceolate and unequal sided. Cotyledons 12 on the average." (Madden).

Stewart describes the crown of the tree as ovate when young and long ovate when old, with broadish top, high branching. Branches springing symmetrically from the trunk, near which they droop, extremities up-curved. Dark green when old, young trees occasionally of a lighter yellowish green (and with shorter leaves.) Bark rough and divided into large longitudinal plates of a gray colour by deep, irregular, longitudinal seams. Leaves 6-18 inches long, stiff and erect, in clusters of three, each with a woolly sheath of ½-1 inch long. Cone somewhat short and thick, 5-7 inches long and 12 inches in girth, on short stalks and growing stiffly from all sides of branches; brown. Scales much thickened, knobby at the points and persistent. Ripe in October. The cones open spontaneously in April and May, and the tree is nearly bare of leaves in May and June.

The *chitr* occurs all through the Kumaon Division, dividing the forest with

Distribution. oak, from 1,600 feet above the level of the sea at Sítakoti, eight miles from Deoprayág in Garhwál, to 7,200 feet on the Pindar river. As a rule, however, 2,500 feet is the lowest height at which it seems to flourish. The *chitr* has the power of driving out all other vegetation from the tracts it occupies, and forests of these trees are seldom interspersed with even the smallest shrubs. Madden and Brandis note the curious phenomenon observable in one-half of these pines in Kumaon. This consists in the spiral arrangement of the bark and woody fibre, the coils being sometimes as much

compressed as those of an ordinary corkscrew, and in some instances the stem itself is thus distorted. Straight trees are found mixed with these contorted specimens in the same forest in Kumaon, and they do not appear to occur in Garhwál or in the higher ranges in Kumaon. The straight variety is known in Kumaon by the term *sapin*. The wood of the straight variety is usually of a reddish white colour, and is preferred for building purposes, as the other is liable to warp and split in working, though in the log form capable of bearing heavy strains. It is, however, rarely used except as fuel. Dr. Jameson thinks the crooked variety is confined to localities with a southern aspect and under 5,000 feet.

The forest survey of 1865-66 estimated the total area under *chir* as 413,650 acres in Kumaon and 152,264 acres in Garhwál.

Webber's survey.

Many acres of forest contain 20 large and 50 small trees per acre; but in a square mile the bare places bring down the average to 20 trees per acre. First-class trees are those having a girth at five feet from the ground of eight feet and over; second class, girth five to eight feet; third class, two feet to five feet, and fourth class under two feet. The first-class trees average about one-twelfth; second about one-fifth, and third about one-third of the total number per acre. This would give a total of 11,318,280 *chir* trees in the Kumaon Division, of which 943,190 belong to the first class.

The forests lying along the Gúmí, Western Rámanga and Eastern Rámanga approximately contain the following trees :—

	Acres.	Trees per acre.			
		1st.	2nd.	3rd.	4th.
Sources of the Gúmí towards Baijráh, ...	61,440	3	5	5	7
Upper Sarju from Kapkot and Phungar valley to Bagesar.	42,380	2	4	5	6
Middle Sarju from Bagesar to Naini bungalow, ...	38,280	1	3	5	7
Lower Sarju and Rámanga from Naini to junction with the Káí.	40,020	2	3	5	7
Middle western Rámanga from Ramari, ...	11,790	1	2	6	7
Lower western Rámanga and Katyár river, ...	32,985	1	2	4	7
Between the Bino and Rámanga beyond Lohba, ...	32,300	2	5	8	12
Between Badhángarh and Latagarh, ...	16,060	3	12	12	12
In the Tarag Tál valley, ...	5,760	2	12	9	12
In the Gúmí valley, ...	8,960	3	10	10	7
To the west of Budha Kidár and Bikiakesain to the east of Masi bungalow.	11,460	1	2	7	12
The Soni jungle, ...	2,560	4	5	8	21

Nearly all these trees grow on slopes rising from the river-beds, and near enough to repay the cost of cutting and launching. The trees on the upper Eastern Rámanga are mostly twisted, though towards Búngidár they are straight and so placed as to be easily shot into the Bino river. Following the stream of the Rámanga, the north-east banks from Garoth down to Bagri have first-class timber covering all the slopes of the Badhángarh and Gopálkot ranges,

and could be easily worked into the Rám-ganga. The Soni jungle near Chaun Debi is one of the finest in Kumaon. The large trees have all straight boles without a knot and with much red wood. The soil is light, micaceous sand on loose beds of earth and stones, which appears to be eminently suited to the *chír*. In Garhwál there are extensive *chír* forests in the valley of the Alaknanda and along the Pindar from Chuding (4,800 feet) to Gwáldam (4,300 feet), a distance of thirteen miles. In the three upper miles the timber is small, but lower down there are fine straight trees close to the river-bank, and a flat near Patíála suitable for a timber depôt. All along here and up the Kail-ganga, for two miles, the forest, could easily be worked. The forests on the Mandákini and Madmahesvar rivers are too high up to be accessible. The forests along the Nayár and Chhíphalghát rivers are extensive and yield good straight timber.

The *chír* is not only useful as a timber tree, but as being the principal source

Resin and turpentine.	of the oleo-resin, the <i>birja</i> , <i>berja</i> or <i>beroja</i> of Garhwál, and the <i>lúsha</i> or <i>lassa</i> of Kumaon, and the oil known as <i>berja-ki-tel</i> or <i>tárptín-ki-tel</i> . The exports of resin in 1867 from Garhwál alone averaged 1,000 to 1,200 maunds of 80 lbs. each, at prices varying from Rs. 3 to Rs. 4-8 per maund in the forest marts along the foot of the hills, which rose to Rs. 5 and Rs. 5-8 at Najíbabad and Káshipur. The average yearly exports from 1869 to 1872 amounted to 30,560 pitchers of resin, which paid a royalty of four pie per pitcher, and sold at Najíbabad at three to four sers per rupee, or about Rs. 10 to Rs. 12 per maund. There are two kinds of resin : (1) the <i>berja</i> sort, which comprises the tears exuding naturally from the bark ; and (2) the <i>bakhar berja</i> , or the resin produced by making deep and long incisions into the sap-wood. The latter is chiefly used by Manihárs and Patwas, who manufacture armlets (<i>chúra</i>) for women. The exports from the Kumaon forests of the first sort during 1869-72 averaged some 86 maunds per annum, which paid a royalty of Re. 1-4 per maund, and 45 maunds of the inferior sort, which paid a royalty of Re. 0-6-8. per maund. The average selling-price during the same years in the Kumaon forest marts was Rs. 10 per maund for <i>bakhar berja</i> resin, whilst in Pilibhít the best sort sold for 8 annas per ser, and the inferior sort for six annas. The resin is highly charged with oil of turpentine, yielding, according to local authority, as much as 70 to 80 per cent. Of late years, attempts to distil the turpentine have been made with success at Najíbabad, Bijnaur, Búrki, and Meerut. At Najíbabad the oil of turpentine sells at from 12 to 14 annas per bottle, and the residue known as <i>sundras</i> , the black colophony of commerce, is sold on the spot at from Rs. 3-8 to Rs. 4-8 per maund. As a rule, the latter is prepared by simply evaporating the spirit in an open vessel by heat and drying the residue, but an improved system of distillation is now common which preserves both oil and colophony. The average annual export of the manufactured oil from the Kumaon forests is about ten maunds, which are subject to a
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royalty of Rs. 5 per maund. A fair specimen of the oleo-resin yielded 75 per cent. of colophony and 10 per cent. of oil on distillation.

Mr. R. Thompson notices that the mode of collection in Garhwál is as follows:—
 “Several deep triangular-shaped niches are cut into and around the trunk of the tree. The niches are from 12 to 18 inches in length from apex to base, and from 6 to 8 inches deep. The base of the niche is hollowed out so as to form a sort of receiver for the resin after it exudes. These are emptied out as filled, which may vary from 10 to 15 days from the time of first cutting. The receivers continue to be filled and emptied several times during the season, which lasts from 15th March to 15th June, or three months. The yield of an ordinary sized tree may be from 5 to 10 sers of *berja* for the first year, and about a third of the quantity during the second year, after which the tree either dies or is blown down by the strong winds which prevail before the setting in of the rainy season. The mode is wasteful : one might fairly assume that at least four-fifths of the resin contained in the tree is lost by this semi-artificial method. The subject is likely to grow into importance as the demand for the article increases, and it would be well to consider before too late the protection of the extensive pine forests that now exist on the slopes of the outer Himalayas, and also of introducing some more ingenious method whereby the whole of the resin contained in the tree might be extracted.”

Of a similar product from Burma, Dr. Forbes Watson writes (1873):—

“The crude turpentine from British Burma has been very favourably reported upon. It is the produce of *Pinus Khasyana* and *Pinus Massoniana*, the market rate being about 4d. per lb in Burma. The reports of the two firms to which the sample was submitted for valuation are:—No. 5—“We have submitted the crude turpentine to the trade, and have their report to the effect that it appears to be of very fair quality. We estimate the market value would be from £12 to £14 per ton.” No. 6—“have carefully examined the sample of rough or crude turpentine and found the quality to be fine and equal to any ever imported from the United States, where the distillation for this market and that of the continent (Bordeaux excepted) is carried on. Crude has ceased to be an article of import; there was not any since 1868, whereas twenty years ago it was a great trade. The nominal value of the sample before us would be 13s. 6d. per cwt. Manifestly, if the value in Burma of this turpentine is about 4d. per lb., or 37s. per cwt., and its value here is only from 12s. to 14s. per cwt., it would be far better to rely upon home consumption.”

The chips of both the *chír* and the *deodár* yield tar by dry distillation. The

Tar. following account of the process is given by Mr. Baden

Powell:—“First an earthen *ghara* or vessel with a wide mouth, and capable of containing about four sers, is sunk in the ground. Next a large *ghara* of about twelve sers capacity is taken, and three small holes

are drilled in its underside : it is then filled with scraps of the pine wood, and over its mouth another small jar is placed, and kept there by a luting of clay very carefully applied ; and then both the jars are smeared over with a coating of clay. These two jars thus stuck together are next set on the mouth of the receiver or *ghara* sunk into the ground, and the joint or seat is made tight by a luting of stiff clay. Light firewood is now heaped around the apparatus and ignited, and kept burning from four to eight hours ; the rationale of the process being that the heat causes the tar contained in the chips inclosed in the large *ghara* to exude, and it falls through the three holes drilled in the bottom, and into the receiver sunk into the ground. When the fire is out, the ashes are raked away, the jars very carefully separated, so that pieces of dirt may not fall into the receiver, and the latter is then exhumed and the contents poured out. It is only necessary to replace the receiver with the jars over it as before, duly charged with chips, and lute the joints up carefully, and the process can be carried on as before. With care the same jars may be made to do over and over again without cracking. One ser of wood yields about 2.6 *chhatáks* of tar and 4.3 *chhatáks* of charcoal. To procure a ser of tar requires 6 sers 4 *chhatáks* of wood chips to charge the pot, and 2 maunds 6 sers and 9 *chhatáks* of chips for fuel. The estimated cost is one anna per ser, but this is far too low."

Pinus excelsa Wallich, *P. Peace*, Griseb. ; *P. pendula*, Griff. *Chál, chár, chátu*, to the west of Jaunsá: wherever *P. longifolia* is known by the name *salla*; *chlla* in Gachwá:; *hail* and *chil* in Jaunsá:; *dol chilla* in Kumaon; *ráisalka* in Central Kumaon; *lín* in Byá:is; *lamshing* amongst the Bhotiyas of Dá:ma. Mallen, Jour. Agri-Hort. Soc., Cal., VII., 80. Brandis, 510; Cooke, 824.

"A large tree, with dark-coloured bark, divided into small irregular plates. Foliage bluish green, or greyish-green in exceptional cases, particularly at high elevations. Leaves in clusters of 5, 6-8 inches long, slender, drooping, sheath and bracts deciduous. Cones erect while young, on peduncles 1-2 inches long or longer, pendulous when mature, cylindric, 6-10 inches long; scales closely imbricate, 2-2½ inches long, 1-1½ inches broad, euneate-oblong, flat, apex (apophysis) not much thickened, rhomboid, the ends rounded. Seeds ovoid, ½ inch long, or a little longer, with an oblong, obliquely truncate wing. Cotyledons usually 9."

Another description makes the tree conical or ovate and low-branched. Branches long and tending to horizontal, their extremities always feathery and a little upturned, unless when weighed down by cones. Rather light or bluish green foliage; often with a greyish tinge when near its high limit. Bark thin, darkish, and tolerably smooth with furrows dividing it into irregular small plates. Leaves six or seven inches long, very slender and drooping in clusters of 3 to 5 (generally five), without a sheath; or short and stumpy when near its high limit. Cone pendent, 8-13 inches long, slender, pea-green or bluish green, often resinous when young. Scales thickish at the end, persistent. Appear in October. By April following they are 3 to 4 inches in length and altogether require 18 months to mature. Flowers from end of April to middle of June, according to exposure and elevation.

Localities.—In Upper Garhwál or Riholi Gudari (a spur from Trisúl) and about Kanol near Rámni; along the Dhauli to the Níti pass and in Byáns. It seems to be absent in Central and North-Western Kumaon. Range may be set down as from 5,000 to 12,140 feet. The forests survey, 1865-66, estimated the total area under this tree at 2,100 acres in Kumaon and 14,042 acres in Garhwál. The following are the principal localities, with the size of the forest and the number and class of each tree per acre:—

Locality.	Acres.	Trees.			
		1st.	2nd.	3rd.	4th.
Kanol, Shatúl on the banks of the Nandákiní, ...	782	1	3	4	4
Above Sirka near Titalakot on the Káil, ...	100	1	1	2	4
On the Vishnuganga, near Pándukeswar, ...	1,290	0	2	3	4
On the left bank and between it and the eastern Dhauli, ...	3,500	1	3	4	5
On the left bank of the Dhauli, ...	3,000	5	5	6	6
On the left bank of the Rishiganga and near Tipuban, ...	5,050	2	4	5	5
Along the Kunti river in Dárma, ...	700	0	4	6	10
On its lower course, ...	1,400	1	6	10	10

The Vishnuganga forests are inaccessible except near Pándukeswar. The tar produced from this tree, *C. Deodara* and *P. longifolia*, is said to be equal to the best Swedish. It is a mixture of resin and oil of turpentine, more or less blackened by the admixture of empyreumatic products. It thickens after exposure to the atmosphere and is used for protecting wood-work in every position.

Pinus Gerardiana, Wallich. The *rhi, shangti* of Kanáwar and Garhwál. Madden, Jour. Agri-Hort. Soc., Cal., VII., 83. Brandis, 508; Cooke, 126.

"A middle sized tree, with a short rounded crown and grey bark, peeling off in large flakes. Foliage dark green, branches smooth, nut-brown. Leaves in clusters of three, 3-5 inches long, stiff, 1½ line broad; sheath and bracts deciduous. Cones while young (catkins) erect on stout scaly peduncles 1 inch long, when mature glaucous, ovoid-oblong, 6-9 inches long, 4-5 inches diameter at base. Lower part of scales 1-1½ inches long, 1-1½ inches broad at top, upper part recurved, obtusely triangular, compressed, spinescent. Seeds cylindric, 1 inch long, with a short caducous wing; edible."

Found at Malári and Bampa in the Níti valley in Garhwál, generally associated with *deodár*. Range from 5,500 to 11,000 feet. It is a small tree, seldom giving a larger girth than 8 feet. The crown of the tree is ovate and somewhat like the *chír*, but shorter, more bushy and conical at top; ordinary height 30 to 40 feet. Branches straggling and not so symmetrical as the *chír*; extremities much curved. Foliage of a dark green with gray branches shining through. Bark furrowed into long, very large, greenish-gray flakes which peel off and show the dark surface below. Leaves three inches long, stiff, glaucous, in clusters of three, with no sheath. Cone like that of the *chír*, 6 inches

long, and thicker, of a bluish colour. Scales thickened at the ends with spinous apex, persistent. Ripe in October.

This tree is very resinous and is much used for torches. Major Longden obtained excellent tar from the chips. Gordon says it affords abundance of fine turpentine and the cones exude a copious white resin. Brandis says it is very resinous, and a white resin also exudes abundantly from the bark and cones.

Cedrus Deodara, Loudon. The *deodár*, *diyár* of Kumaon and Garhwál; the *kelon*, *kehs* of western Garhwál and Jaunsár, where the name *deodár* is given to the *Cupressus torulosa*. Madden, Jour. Agri.-Hort. Soc., Cal., VII. Brandis, 516; Cooke, 122; Roxb. 677.

"A large tree with dark-coloured bark, the extremities of branchlets drooping while young. Foliage dark green; lighter, sometimes bluish green in young trees. Leaves 1-1½ inches long, rigid, sharp, triquetrous, the leaves of 3-5 years on the branches. Cones erect, 4-5 inches long and 3-4 inches diam., ovoid or ovoid-cylindrical, obtuse, scales closely imbricate, broadly cuneate, 2-2½ inches broad and 1-1½ inch long, the upper edge rounded. Seeds ½ inch long, wings large, triangular, with rounded sides. Stewart describes the trees as having the crown pyramidal and low branching."

The branches are straight and spreading nearly horizontally from the trunk and their extremities are either horizontal or slightly drooping. Trees frequently having several trunks and often table-topped: bark thick, dark and rather smooth, longitudinal fissures dividing it into long and narrow plates: leaves an inch or more long, three-sided, sharp, needle-like, thinly scattered all round the new shoots or in tufts of 40 to 50: cone erect, cylindrical, 4 inches long and very thick, darkish brown: scales thin, closely applied and deciduous: ripe in October.

There are a few scattered plantations near the temples at Debi Dhúra, Gangoli, Lodh, Bála Jagesar, Pharka, Lohúghát and elsewhere, but no natural forest occurs save on the Nandákini river in Garhwál, and there only about 1,500 acres. The area under *deodár* in Kumaon has been estimated at 221 acres. The other localities are as follows:—

"At Parmatti, near the Nandákini; and at Shatúl, a very fine grove. A grove of about 16 acres exists at Chaitra Pál near Somesar: groves are also found at Súi, Rikhesar, Mantesar, Kalsin, Simalti and Gatúk, near Lohúghát. Along the eastern Dhaulí, from Kák to Malári, is a natural forest of *deodár* containing about 1,400 acres, giving one second-class, three third-class, and eight fourth-class trees to the acre. At Lata, on the Rishiganga, a confluent of the eastern Dhaulí, there are about 70 acres of fine, healthy trees, one giving a girth of 30 feet. Average girth in these Provinces of the largest trees about 14 feet. It does not appear to be indigenous in Kumaon, and wherever it appears has evidently been planted. The *deodár* yields an oleo-resin similar to that of the *chár*, and the oil is used in medicine and sells at about eight annas per ser in Pilibhít. The great *deodár*-producing forests belonging to these provinces are in Jaunsár Báwar and the Bhágirathi valley, and these are sufficiently described by Brandis, 517.

Abies Smithiana, Forbes. *A. Khutrow*, Loudon. *A. spinulosa*, Griffith. *Pinus Smithiana*, Wallich. *P. Khutrow*, Royle. *Picea Morinda*, Link. The Himalayan spruce; the morinda and rái of Jaunsár; *kandre*, *re*, *rhái*, *ráo*, *kudrans*, *rái ala*, *rágá*, *kail*, *karchala* and *kilu* of Garhwál and Kumaon. Madden, Jour. Agri-Hort. Soc., VII, 87; Powell, I., 564; Cleghorn's analytical key to the Conifers. Brandis, 525; Cooke, 127.

"A large tree, with tall straight stem, pyramidal crown, dark-green foliage, and pendulous branchlets. Leaves single, scattered in spirals all round the branches, persistent 5 years, stiff, sharp, 4-sided, 1-1½ inches long. Cones terminal, pendulous, cylindric, obtuse, 4-6 inches long, 1-2 inches diameter, dark brown when ripe; scales broadly ovate from a cuneate base; upper edge thin, sharp, rounded. Seeds small, 2½ lines long, with large spatulate wings."

Madden describes it as a tall tree with narrow branches sloping downwards or nearly horizontal, with depending tassel-like twigs all along, the extremities bushy. Foliage somewhat light or bluish green. Bark smooth, tessellated into small squares by shallow furrows. Leaves about an inch and a half long, sharp-pointed, stiff, solitary and thickly scattered around branches and twigs. Cone pendent from tips of branches, oblong cylindrical, 6 to 7 inches long; brown or purple. Scales thin with membranous edges, persistent. Ripe in October. Flowers in April with solitary strobili, and immediately afterwards exhibits numerous cones, rapidly enlarging to several inches in length. The young cones are at first upright, but afterwards become pendulous. Found in the north of Garhwál near Joshimath and in the Dhauri and Vishnuganga valleys. The forest survey of 1865-66 estimated the area under this tree in Garhwál at 26,908 acres. The following are the principal localities, with the size of the forest and the number of each class of tree per acre:—

Locality.	Acres.	Trees.			
		1st.	2nd.	3rd.	4th.
Near Kunal, Peri and Shatúl on the upper Nandákini,	6,828	2	3	4	4
On the slopes of Tamba Deo near the eastern Dhauri,	50	1	3	3	3
Near Golahkot on the left bank of the eastern Dhauri,	2,050	5	5	5	7
On the Biráganga and Rishiganga, ...	13,000	5	4	5	7
Further up the Rishiganga, ...	4,980	2	4	6	8

It does not appear to be common in Kumaon. The average number of trees in the fine forests on the Nandákini is about ten to the acre. Both Stewart and Royle mention this tree as a resin-bearing conifer.

Abies Webbiana, Lindley. *A. Pindrow*, Royle. *A. densa*, Griffith. *Picea Webbiana*, Loudon and Wallich. *Pinus spectabilis*, Lambert. Himalayan silver-fir.

Madden separates the variety known as *Picea Pindrow*, Royle, from *A. Webbiana*, Wallich, though the names of both are the same in the vernacular: *rágá* and *ráo rágá* in Kumaon; *wúman* amongst the Bhotiyas of Dárma; *bang*, *dodhma rágá*, *teiya* or *chili rágá* in south-eastern Garhwál; *chílrao* in central Garhwál; *morunda* in north-western Garhwál and Jaunsár; *raunsá* or *rái salla*

about the sources of the Kosi in parganahs Bárahmandal and Dánpur and on the Dúdu-ki-toli range near Lohba in Garhwál. Madden, Jour. Agri-Hort. Soc., Cal., VII, 96. Brandis, 528.

"A large tree, with a dense cylindric crown of dark-green foliage. Leaves single, spirally arranged all round the branchlets, but generally more or less spreading in one plane so as to appear distichous, flat, narrow-linear, 1-3 inches long, 1 line broad, narrowed into a short terete petiole, apex emarginate, or with 2 sharp teeth, underside with 2 whitish longitudinal furrows on either side of the raised midrib, upper side dark-green, shining. Duration of leaves 8-10 years. Catkins axillary, cylindric, obtuse, about 1 inch long. Cones erect, subsessile, cylindric or ovoid, often clustered, obtuse, 4-6 inches long, $1\frac{1}{2}$ -3 inches diam., dark purple or brownish purple when ripe. Scales closely imbricate, broadly cuneate or obovate, edge rounded, bracts many times shorter than scales. Seeds oblong or obovoid, half the length of the broad obovate truncate wing. Two varieties, considered as species by Royle, Madden, and Parlatore: (a.) *A. Webbiana*, on exposed rocky ridges at higher elevations: a smaller tree, with shorter, less bifarious leaves, and usually thicker and shorter cones: (b.) *A. Pindrow*, on better soil, in sheltered places, a large tree, with longer leaves and generally cylindric cones. The scales fall when the seed ripens, and leave the naked persistent axis of the cone standing upright on the branches."

Madden thus describes his *Picea Pindrow* of Royle:—

"It flowers in April and May, when the young shoots are of the brightest green, the old leaves being nearly black. The trunk is branched nearly to the ground, but cones are produced only on its loftiest boughs. By the middle of May the cones are about 3 inches long by one in diameter, and more or less cylindrical. As the season advances, they become more or less completely so, and of a rich dark purple colour. They ripen in October and November. The cones of *P. Webbiana* are less cylindrical, thicker and shorter, and the bracteoles more rounded, scarcely emarginate, and with a thicker and longer apex. The spiral arrangement of the scales seems identical, and each has the same copious supply of white resin. The cones of *P. Pindrow* are perfectly cylindrical; the scales more prominently eared; bracteoles oval, obtuse, eroded, emarginate, the mucro of the same length as the border of the sinus."

Forms dense forests on all the great spurs towards the heads of the Pindar, Sarjú, Eastern Rámanga and Káli rivers: near the sources of the Kosi at Bhatkot and on the Dúdu-ki-toli range, near the sources of the eastern Rámanga, from 7,500 to 9,000 feet. Also on Surkhanda near Masúri, at 9,200 feet. It gives a girth at five feet from the ground of 12 to 17 feet. The timber is generally used for house-building purposes and lasts well where protected.

The other variety is thus described as the *Picea Webbiana* of Wallich:—

"Tree tall, very narrow and like the cypress. Branches short, thick, scrubby, and declining at the extremities. Foliage very dark green; near its upper limit of a grayer colour. Bark somewhat smooth, tessellated by shallow furrows into small squares; young branches silvery. Leaves three-quarters of an inch to two inches long, flat with three small points, in two rows on either side of branches and twigs.

Cone erect, rather short, cylindrical, dark purple, scales broad, dark-coloured near edge, deciduous. Ripe in October. The tree flowers in May, when the strobili are of a purplish red. Remarkable for its upright columnar appearance."

Rámni on one of the spurs of the Trisül, between the Pindar and Alaknanda up to the glaciers, and on the summit of Dúdú-ki-toli.

Localities.

The forest survey, 1865-66, gave an estimated area for Kumaon of 13,110 acres, and for Garhwál of 53,280 acres. The principal localities, with the number of each class of tree per acre, are as follows :—

Locality.	Acres.	Trees.			
		1st.	2nd.	3rd.	4th.
On the left bank of the Nandákiní in Garhwál, at Chatí Bukiyál and Gúdari Bukiyál, ...	790	1	1	7	6
At Shik, Kunál and Shatúl, near the same river, ...	5,600	2	3	3	3
Above Kinoli in the Pindar valley, ...	1,040	2	6	7	12
On the Kailganga and above the Pindar, ...	1,230	1	6	8	9
On the Pindar from Gumra Pani to Chuding, ...	3,680	1	4	4	7
Between the Pindar and Sarjú and east of the Rám-ganga, ...	1,890	2	2	3	3
In Chaudáns and Byáns, ...	2,440	2	4	6	8
On the spurs of Tungnáth, and in the valleys of the Nigholi and Balsúkhi rivers, ...	4,370	2	4	4	5
To the left bank of the Alaknanda, on the Páikánta and Ramari ranges, ...	6,070	4	4	6	8
On the left bank of the Eastern Dhauli, ...	15,100	5	5	...	8
On the upper Nyár, ...	3,200	2	6	8	10
Dúdú-ki-toli range, ...	8,800	2	6	8	10
On the spurs of Panch Chúlga, ...	3,970	5	5	7	8
Deo Thal in Agar Patti, Kumaon, ...	3,200	1	2	4	4

The forests on the Pindar could easily be worked, and that river can carry the largest logs with ease. Those on the Balsúkhi and on the Nandákiní, near Kedarnáth, are too high up to be accessible. Nothing is known regarding its resinous properties. Classes as in *chitr*; first, 8 feet in girth and upwards; second, 5 to 8; third, to 5; and fourth, under 2 feet: see Madden, Agri-Hort. Soc., Cal., VII., 102.

Abies Dumosa, Loudon. *Pinus dumosa*, Don. *P. Brunoniana*, Wallich. Hemlock spruce of Nepál; the *tungsing* of the Bhotiyas of Dárma in Kumaon; *changathasi dháp* of Nepál. Madden, Journ. Agri-Hort. Soc., VII., 95; Brandis, 527.

"A large tree, with spreading branches and pendulous branchlets. Leaves narrow-linear, $\frac{3}{4}$ -1 inch long, edge recurved and finely serrulate near the apex, covered beneath with a white mealy substance. Male catkins short, subglobose, axillary, shorter than leaves, pedunculate; numerous lax ovate bracts at the base of peduncle. Cones terminal, erect or horizontal, ovoid, 1 inch long, scales persistent, broad elliptic, obtuse, bracts not apparent when the cone is ripe. Seeds winged."

It grows to a height of 80 to 100 feet, with a girth of 10 to 12 feet, and occurs in Dárma of Kumaon and about the Chipula range at 9,000 to 11,000 feet. The forest survey in 1865-66 gave the total area under the silver cypress at

3,650 acres in Kumaon. The principal localities, with the size of the forest and the number of trees per acre according to class,* are as follows:—

Locality.	Acres.	Trees.			
		1st.	2nd.	3rd.	4th.
Dola Kot and Kála Mundi, to the west of the Gori river, mixed with <i>Abies Webbiana</i> .	140	1	2	2	4
In Chaudáns and Byáns, to the north-west of the Dhauli.	650	2	6	5	5
Manktil dānda and in the valley of the Chirkila gár, falling into the Dhauli.	1,160	1	2	3	3
At Titáls Kot near the Káli, ...	600	2	3	3	4
Spurs of Panch Chúla above Tánik, ...	920	2	4	6	6
In Byáns near the Káli, ...	1,000	2	4	4	10

Dr. Hooker found specimens in Sikhim with a girth of 27 feet at five feet from the ground. The timber is said to be inferior to that of *A. Webbiana*, being liable to warp: the bark is used for thatching purposes. Nothing is known regarding its resinous properties.

Cupresses Torulosa, Don. Himálayan cypress. *Sárái*, *sarái*, Kumaon and Garhwál; *raí salla*, Naini Tál; *leawri* of Jaunsár; to the west and towards Simla it is called *deodár*; and the name *sarái* is given to *Juniperus excelsa*; it is the *tangshin* of the Bhotiyas of Dárma. (H. Strachey): Madden, l.c.; Brandis, 533.

"A large tree; branches horizontal, whorled with drooping extremities, forming a broad pyramidal crown. Branchlets round or indistinctly four-sided; leaves ovate-triangular, white margin-ed. Cones numerous, clustered, erect, bluish when ripe, $\frac{1}{2}$ inch diameter; scales flat or convex, rugose, but smoother than those of *C. sempervirens*. Seeds compressed, convex on both sides, with a narrow orbicular wing."

Found in Chaudáns, Naini Tál, Dhol; of remarkable size on the upper Nandákini near Rámni, on the Kailganga in Garhwál, and from Joshimath to Nfti. The forest survey of 1864-65 estimates 1,200 acres of cypress in Kumaon and 4,938 acres in Garhwál. The principal localities, with the number of trees in each, are as follows:—

Locality.	Acres.	Trees.			
		1st.	2nd.	3rd.	4th.
Right bank of the Nandákini near Ramni, Gúni, Búra, Barkuna, Shík, Ali Bukiyál and Wán, near the source of the Kailganga.	17 601	1 3	3 3	6 6	10 6
On the Kailganga and at Ketha and Melkhet, on the Pindar and higher up.	378	3	4	5	4
Near Pándukeswar on the Vishnuganga, a difficult river,	150	...	2	3	4
On the left bank, and near the slopes of Tamba Deo,	1,790	1	2	3	4
In the valley of the eastern Dhauli, from Samangwenta to Malári.	1,585	1	2	4	5
Near Turág Tál, ...	100	2	2	4	4
Naini Tál, ...	160	2	4	6	6

* Class as in *A. Webbiana*; See Madden, Journ. Agri-Hort. Soc., Cal., VII., 95.

In north-east Kumaon, it occurs along the Kálmundi range, separating the Rámganga from the Gori, but it does not appear in north-western Kumaon. The older trees in a favourable climate grow up in a slender column like the *A. Webbiana*, and, except that the foliage is a yellowish green, considerably resemble it in its sombre colour and columnar appearance. The thick contorted boughs also give it a rough appearance. At Naini Tál the boughs with a southern aspect are fuller and more regular, giving the tree a lop-sided appearance. The wood is often burned as incense and yields a resin.

Juniperus Communis, Linn. Varieties *alpina*, *nana*; ground cypress; *padma* and *parpinja* of Niti; *churpinja* of the Máns valley; *lhala* of Byáns, but H. Strachey names the *lhala* of Byáns as *J. religiosa*; the *chichia* of Milam. Madden, Journ. Agri-Hort. Soc., Cal., VII., 153-5. Brandis, 535.

"A dense, diffuse shrub; in Europe sometimes a small tree, procumbent at great elevations. Foliage grayish green. Leaves spreading, in whorls of three, linear, $\frac{1}{4}$ - $\frac{1}{2}$ inch long, pungent, narrowed at base, nearly flat and bluish green above, light green, convex or obtusely keeled beneath, persistent 3-4 years. Catkins axillary, supported at the base, by small bracts; the male ovoid, yellow; the antheriferous scales broad-ovate, acuminate; the female flowers small, resembling leaf-buds. Berries sub-globose, on short scaly stalks $\frac{1}{4}$ - $\frac{1}{2}$ inch long, crowned at the apex with the tips of the carpellary scales; pulp sweet and resinous. Seeds generally three."

Madden describes the tree thus :—

"The foliage has a pale yellowish-green tint, leaves in whorls of three, half-spreading, linear, very acute, pungent, about a third of an inch long, convex below, concave and very glaucous above; the fruit and twigs exuding an exceeding rank turpentine and resin. The fruit ripens in August and November; berries large, round, dark blue, covered with glaucous bloom; extremely resinous and aromatic. On the apex are three diverging furrows, connected at the extremities by an elevated scale, and thus forming a kind of platform on the top of the berry. Lower down are three large lateral scales. Seeds always three, oblong, angular." It is found on Chítu Benaik (10,500 feet); at Milam, Tola (11,000—12,000 feet); Bampa, Malári, Jelam (9,000 feet), and Rimkim (14,000 feet), and is said to be used as one of the sources of incense. The twigs are resinous and aromatic.

Juniperus Recurva, Ham. Weeping blue juniper; the *better*, *bheddra*, *jhora*, *gágal*, *aru* and *agáni* of Kumaon and Garhwál; the *bil* of Milam; *padhank* and *pama* of Byáns. Madden has a valuable article on this tree in Journ. Agri-Hort. Soc., Cal., VII., 146. Brandis, 536.

"A gregarious shrub or moderate sized tree; branchlets decurved or drooping. Leaves adpressed, $\frac{1}{4}$ inch long, in whorls of 3, generally approximate and imbricate, distant on older branchlets, lanceolate, pungent, back convex. Catkins and berries at the ends of short lateral leaf-bearing branchlets. Berries oblong or ovoid-oblong, pointed, $\frac{1}{4}$ - $\frac{1}{2}$ inch long, with the tips of carpellary scales near the apex, green at first, olive or blue afterwards, dark-brown or almost blackish-purple, smooth, shining when ripe. Seed 1, oblong, obtuse. *J. squamata* is a procumbent variety with broader, curved leaves, and is thus described:—"A procumbent species found at high elevations, 9,000—15,000 feet."

There are two varieties, one with acute spreading leaves, found at 12,000 to 13,000 feet; the other with imbricated cypressiform leaves and extending to nearly

15,000 feet. It flowers from May to August, and the fruit ripens from July to November. In form it is a decumbent much branched shrub, with ascending branchlets; the leaves in threes, closely imbricated, ovate-oblong, more or less acute, inflexed at the apex as if obtuse, the withered ones persistent with a very long point and adhering to the branches like scales. The berries vary from light blue to nearly black and are ovate-obtuse, very glossy, one-seeded, with three to four opposite scales about the centre and two smaller ones near the top, which is umbilicate and furrowed.

It occurs beyond Milam and Nítí; in the valleys of the Dhauli, Vishnuganga and Kedárganga: at Pindari and most other glaciers.
Localities. Madden's notice, Journ. Agri-Hort. Soc., Cal., VII., 146, should be read. The shrub is sacred and its resinous twigs are used for incense.

Juniperus Excelsa, M. Bieb. Himálayan pencil cedar; *Shárbuta*, *shárgu*, *shákpa* of Tibet; *dháp*, *padmak*, *sárgt* of N.-W. P.; *padmak* of Milam. Madden, Journ. Agri-Hort. Soc., Cal., VII., 138-146. Brandis, 538.

"A small or middle-sized tree, stunted at high elevations, with slender, terete, nearly distichous branchlets. Foliage light green, not unlike in colour that of *Pinus excelsa*. Leaves of two kinds (dimorphous); on the upper and outer branches, scale-like, closely adpressed, imbricate, ovate, acute or pungent, back convex with a resinous gland; on the lower branches, subulate, pungent, $\frac{1}{2}$ inch long. Male catkins terminal. Berries very resinous, $\frac{1}{2}$ inch diameter; sub-globose, black when ripe, at the ends of lateral leaf-bearing branchlets of variable length, $\frac{1}{2}$ - $\frac{3}{4}$ inch long. Seeds 2-5."

This is another of the sources of Tibetan incense. It grows to a height of 40 feet at the upper limits of *A. Webbiana* (8,900-11,500 feet) beyond Milam; at Jelam on the Dhauli (9,000 feet) and in the valley of the Girti. In Nepál it grows to a height of 60 to 80 feet, and is there a fine large tree with dense branches of a dark colour and close foliage. In Sikhim it falls to from 15 to 20 feet. Madden notes that the Kumaon tree has a scaly bark; the heart-wood is red and odorous, and the leaves are quadrifariously imbricated, and the wood is burned as incense. The juniper is often confounded with the cypress; the former, though the ultimate ramifications are very numerous, has them much shorter and less pendulous than the cypress, and the green is more brilliant. The leaves are closely imbricated in decussate pairs, somewhat obtuse, with a central gland or raised line on the back; four-ranked and imbricate; or slender, acute, disposed in threes and spreading. The fruit ripens in September-October, of a purplish blue colour, the size of a small pea, one or two-seeded, with a strong aroma when bruised.

Taxus Baccata, Linn. *T. nucifera*, Wall. *T. Wallichiana*, Zucc. Yew. *Tháner*, Kumaon; *léet*, Sor; *nhare*, Byáns; *geli*, *galla*, Bulsun. Madden, Journ. Agri-Hort. Soc., Cal., VII., 155. Brandis, 539.

"A large tree with dense, dark green foliage. Leaves linear, 1 line broad and $1\frac{1}{2}$ inch long; apex sharp, base narrowed into a short petiole, decurrent along the branch, with two raised lines. Male flowers yellow. Fruit, a red ovoid berry, somewhat more than $\frac{1}{2}$ inch long, open at the mouth, so that the top of the dark olive-green seed appears."

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The yew is found at Bála Jagesar, 5,900 feet; Puya páni, on the road to Deo Dhúra, 6,500 feet; on Thákil in Sor; Kanál on the Nandákini; Chipula in Chaudáns; Ladúli ghát on the Nayár and near Tungnáth. The gummy exudation forms a portion of the incense used in Tibet.

Tectona Grandis, Linn. fl. Teak. *Ságan, ságu*. Brandis, 354; Cooke, 128; Roxb., 302.

"A large deciduous tree; branchlets four-sided and channelled, with large quadrangular pith. Leaves opposite and entire, oval or obovate, blade 1-2 feet long, 6-12 inches broad, petiole 1-1½ inch long, in seedlings and coppice-shoots the leaves much larger, 2-3 feet long; upper side rough, under side clothed with dense, stellate, gray or tawny tomentum; main lateral nerves prominent, 8-10 pair, with 2 or 3 large branches near the edge of leaf, joined by numerous parallel transverse veins. Flowers 5 or 6-parted, white, on short pedicels, in large erect terminal cross-branched cymose panicles 1-3 feet long, with short lanceolate bracts; ovary 4-celled; stigma bifid. Fruit subglobose, more or less indistinctly 4-lobed, ½ inch diam., the thick spongy pericarp consisting of a dense felt of branched hairs; the nut uneven with 1, 2, 3, rarely 4, seeds, and a central cavity having the appearance of a 5th cell. When the seed germinates, the outer wall of each cell comes off bodily like a round, concave cap. The inflated calyx, enclosing the fruit like a bladder, is generally ovoid, sometimes depressed, reticulate, and more or less crumpled or irregularly plaited; 1-1½ inch diameter."

Wood-tar from this tree was submitted to Mr. G. E. Evans, who made the following report:—"I have examined the wood-tar you sent me, and I find that it contains all the ingredients to be found in coal-tar, but in different proportions relatively to each other. I am of opinion that, if used in every way in which coal-tar is made available, its effects would be much less permanent than the former, particularly if exposed to the action of the atmosphere, but this could only be proved by actual experiment, and by noticing its effects for a length of time. I am convinced that it might be rendered much more valuable by concentration, say, by exposure to the sun's rays for a short time in large evaporating pans, as it would then part with a large amount of watery vapour which it contains in a free state." (Agri.-Hort. Journ., Vol. XL, pp. xlv.-lii.)

R. A. Sterndale of Seoni remarks of this substance, that "teak tar is not made and sold in very large quantities by the natives here, for it is used by them only medicinally; I am, therefore, unable to give you the district rate of sale, but from recent experiments the cost is as follows:—In the first place the wood, that which has been cut about three months is the best; if too fresh the tar is thinner; about 20 sers of the above wood will yield one ser of tar, to extract which from one to two maunds of coddung fuel (which is always used) is required, this costs about two annas a maund; allowing the full quantity of fuel, which would be four annas, say one anna for the wood (which is over the price) and two annas daily hire to a man to attend the distilling, the maximum cost of one ser of tar is seven annas. If a larger quantity is made, of course it would be cheaper, as one man could attend to several distilleries. I should say 4 annas per ser is a fair average. From three to six sers according to loca-

lity can be obtained here. Yesterday I measured off a cubic foot of good teak and had it distilled; the product was about one ser of tar, the fuel one and a half maund of dried cowdung."

ELASTIC GUM-RESIN.

This seems to be the place for the elastic gum-resin produced by the *dk* or *madár* so common in these provinces.

Calotropis Gigantea, R. Brown. *Madár, dk*, H. Drury, 100; Brandis, 331.

"A shrub, 6-10 feet; leaves stem-clasping, decussate, oblong-ovate, wedge shaped, bearded on the upper side at the base, smooth on the upper surface, clothed with woolly down on the under side: segments of corolla reflexed, with revolute edges: staminate corona 5-leaved, shorter than the gynostegium; leaflets keel-formed, circinnately recurved at the base: incurved and subtridentate at the apex: umbels sometimes compound, surrounded by involucreal scales; foliicles ventricose, smooth, seeds comose; flowers rose-colour and purple mixed."

C. Hamiltonii, Wight. *Madár, dk*, H. Drury, 103; Brandis, 331.

"A shrub, 6-10 feet; lobes of the corolla patulous, revolute on the margin: leaflets of the crown of the stamens equalling the short depressed gynostegium, the circinnate portion short, often acuminate."

Both these shrubs yield an elastic gum-resin, which is procured by making incisions in the plant and is used as a substitute for gutta-percha. Dr. Riddell calculated that ten average-sized plants will yield as much juice as will make one pound of this substance. The juice when collected is evaporated in a shallow dish, either in the sun or in the shade, and, when dry, the substance is worked up in hot water with a wooden kneader in order to get rid of the acidity of the gum. The following account¹ of some experiments made with the juice will prove interesting:—

"About 18oz. of fluid *madár* juice was collected and strained through a cloth, and 13½ ounces were exposed to solar evaporation on a flat dish. In three days it became firm, separating itself from the dish and easily removed. It was then placed in boiling water and worked well about with a spatula, and when cool enough to handle it was kneaded with the fingers. When cool it weighed a little more than 6oz. It was then boiled, and as it cooled was well worked again; on being weighed the substance was found to have lost one ounce. It was then pulled out into shreds and boiled a second time, kneading it whilst cooling, and 4oz. 2drs. apothecaries' weight was obtained of what is called *madár gutta percha*. The next experiment was with 4 oz. apothecaries' weight of the juice; this was placed in a basin; about one quart of boiling water was poured on it, stirred up and then left to stand, when it broke into curds which fell to the bottom. The fluid was then partially poured off and the residue was filtered through paper, and on its being sufficiently dry to be removed it was found to weigh 1oz. 6drs. It was then worked well in hot water two or three times, and formed into a

¹ Journ. Agri-Hort. Soc., Cal., VIII., 111.

mass which gave 6drs., thus losing 1oz. On the whole, it will be seen that the most economical method of preparing the juice is by solar evaporation, the residue being nearly double to that of the second experiment. Result of the experiments in acids, alcohol, *liquor potassæ*, and spirits of turpentine, on equal quantities of the *madár* made into small pellets, immersed 48 hours. *Sulphuric acid*—Much charred, particularly outside. Cut a pellet in half; found the inside spotted, not charred throughout; the remaining part stretching like tough dough. *Nitric acid*—Appeared converted into a yellow resinous substance and gained about one-third in weight, which it lost again when dry; found it pliable under pressure of the finger; when mixed with water it coloured yellow. *Muriatic acid*—Coloured somewhat like the sulphuric, but not so black; soft and plastic. No increase in weight. Colour brownish outside with a reddish tinge inside. *Acetic acid*—No diminution in weight whatever; apparently the same as when first immersed. *Alcohol*—The substance apparently softened and lost a trifle in weight; spirit slightly discoloured. *Liquor potassæ*—Washed it in warm water and let it dry; had a yellowish tinge. Increased a little in weight, but became very ductile and adhesive. *Spirits of turpentine*—Placed one part in four of turpentine, and in twelve hours it was quite dissolved, forming a thick creamy substance which, mixed with spirits of wine, would make a good varnish for silk or cloth."

The juice is used to destroy the offensive smell of fresh leather, and yields a principle known as *madarine*, which is applied externally in the cure of certain cutaneous affections. The *madár* has long been famed for yielding a kind of manna known as '*shukr-ul-ashar*' or '*madár-ke-shakr*,' which is caused by an exudation from the piercing of an insect called *galtigál*.¹

¹ Royle, *III. Bot. Him.*, 275.

